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AUGUST, 1920

AIR ESCAPING SURFACEWARD FROM TUNNEL HEADING THAT IS BURROWING ITS WAY UNDER EAST RIVER, N. Y.—SEE LEADING ARTICLE.

Driving With Air the Hudson Vehicular Twin Tubes
Robert G. Skerrett

San Joaquin Light and Power Corporation's Kerckhoff Power Project
W. C. Collyer

Actualities in Industrial Russia of Today
A Former Compressed Air Machinery Man

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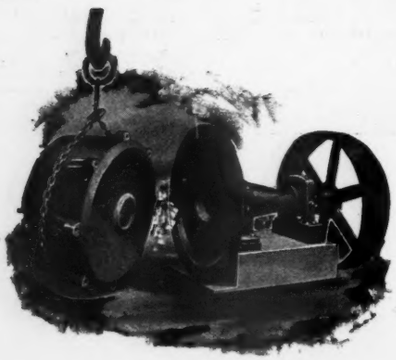

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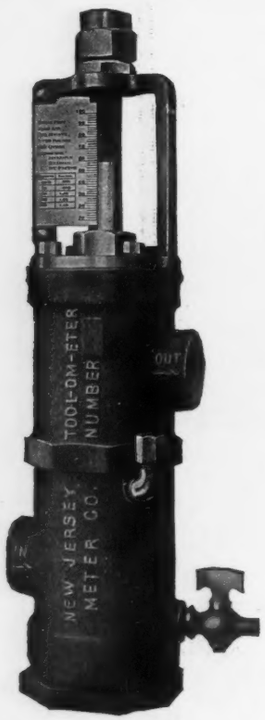

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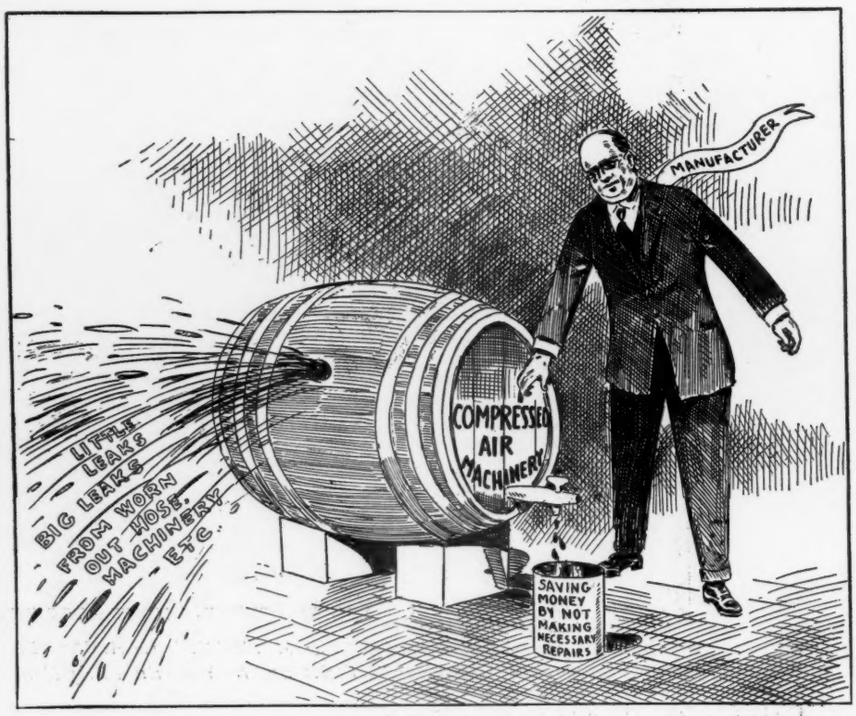

SAVING PENNIES ON REPAIRS—WASTING DOLLARS IN AIR LEAKAGE

The above cartoon reprinted from Compressed Air Magazine; April, 1920, page 9633, shows the plight of any air user who fails to investigate his losses.

Write for Bulletin 5-A

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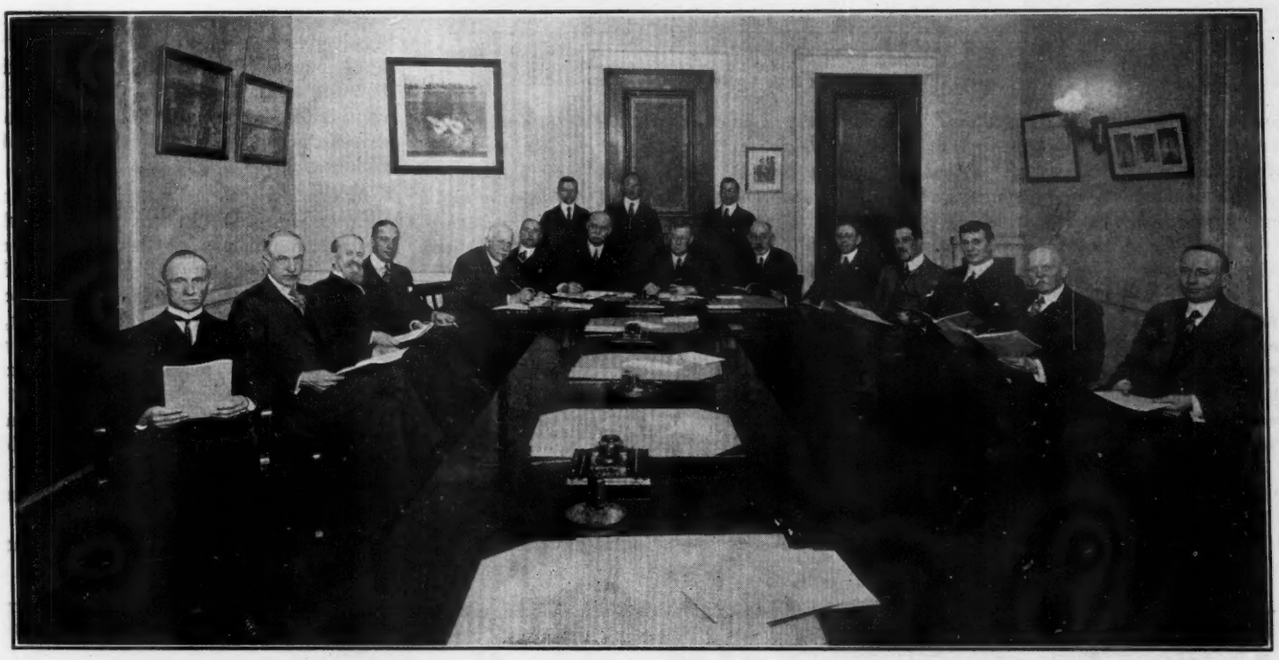
AUGUST, 1920

Driving with Air the Hudson Vehicular Twin Tubes

An Expert Engineering Analysis of the Great Undertaking to Cost $28,670,000 Which Means Multiplication of the Main Freight Traffic Arteries of the World's Metropolis

By Robert G. Skerrett



New York and New Jersey Commissions Executing agreement to undertake the Construction of the Vehicular Tunnel.

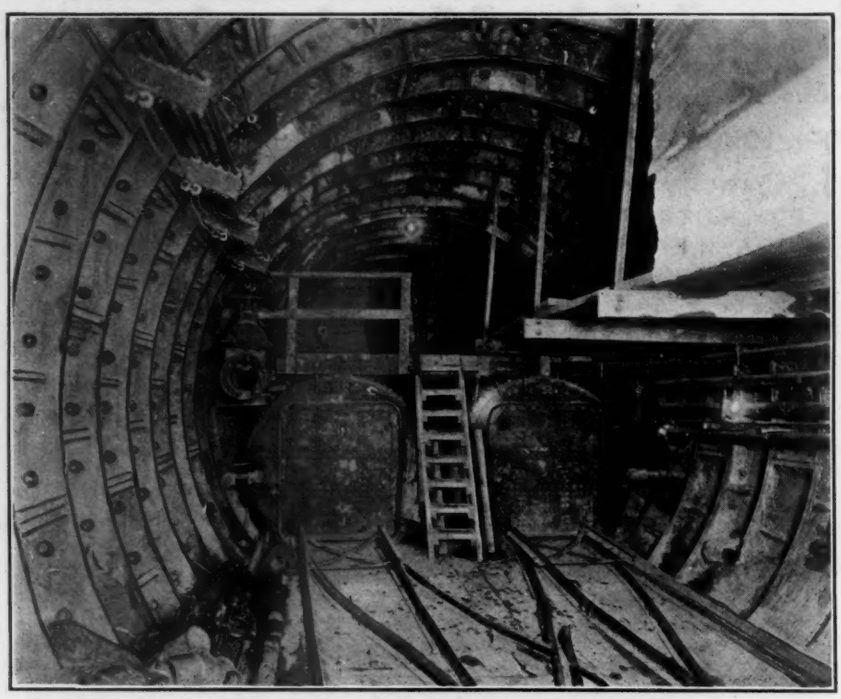
Seated, left to right—Messrs. Barlow, Adams, Collings, Boettger, Campbell, Richards, Noyes, Dyer, Bloomingdale, Williams, Whalen, Shamberg, Hawkes, Windels. Standing, left to right—Messrs. Barradale, Holland, Frohlich.

AMPLIFYING New York's arteries; multiplying the circulatory channels of the metropolis. Such, in short, is what is now to be done through the building of the twin-tube vehicular tunnel authorized by the States of New York and New Jersey.

The wonder is that two enterprising and interesting commonwealths should have waited so long before agreeing to push such an undertaking actively. Near-by New Jersey and Manhattan, especially, have had their comparative physical isolation emphasized again and again as one cause or another has interfered with free and rapid traffic intercommunication. It is probably not overstating the fact in declaring that the intervening Hudson River has indirectly cost the peoples of the two states hundreds of millions of dollars in the course of the last ten years.

Much as the water highway has facilitated the carriage of both freight and passengers from shore to shore, still seasonal conditions have every now and then woefully hampered the movement of essential craft. Obscuring fogs have settled upon the river, making navigation dangerous, and slowing up to a great extent the travel of laden shipping; again, the sweep of opposing tidal currents has either hobbled or halted lighterage activities—checking for hours the transfer of a tremendous tonnage of important commodities; and then, as most New Yorkers know to their inconvenience and discomfort, winter weather and obstructing ice have all but closed the North River to any but the largest of steamers. Finally, dissatisfied harbor workers have placed at their mercy a vast populace simply because they have had it in their power to paralyze local marine facilities.

However, the legislatures of New York and New Jersey have now provided an initial sum wherewith to take the first practical steps towards changing this state of affairs, and their constituted commissions have agreed upon the construction of a two-tube tunnel ca-



A close-up view of a subaqueous tunnel heading showing the air-locks by which the front of the shield is reached by the sand-hogs and by the dump cars employed in carrying the excavated spoils to the rear. Needless to remark, here is where compressed air holds supreme.

pable of accommodating the steady flow of four lines of traffic. In the engineering field it is so often the boast of America that it leads the rest of the world, but in this instance, at least, we must acknowledge that we are going to follow the path blazed for us by the most progressive of British cities. Novel as a vehicular tunnel will be to us, London set the pace by building the Blackwall Tunnel under the Thames back in 1897, and eleven years later opened the longer and bigger vehicular tube, the Rotherhithe Tunnel, under the same river. These subaqueous viaducts have well repaid the foresight which called them into being. The Blackwall Tunnel is 6,200 feet in length, is cast-iron lined, and has an external diameter of 27 feet. The roadway is sixteen feet wide flanked by two sidewalks each three feet and one and a half inches in width. The Rotherhithe Tunnel, also cast-iron lined, has an outside diameter of 30 feet, and the free space within suffices for a sixteen-foot roadway and two foot walks, each four feet and eight and a half inches wide.

While we have lagged behind the British capital still, as will be learned presently, the New York-New Jersey vehicular tunnel will, in most respects, be a more pretentious project and will involve a number of technical problems that did not enter into the tasks confronting the English engineers. To begin with, the span is a wider one in the case of the North River undertaking, and from entrance to exit each tube will be 9,425 feet long. This will call for artificial ventilation of a scope and character not necessary under the conditions prevailing in either the Blackwall or the Rotherhithe tunnels.

The river bed of the Hudson is composed largely of semi-fluid silt and yielding mud along the line chosen, and dealing with these more or less unstable materials presents troublesome features quite unlike those offered by the firm mass of clay and gravel through which the two London subaqueous vehicular tubes were driven. Finally, the magnitude of the tunnel builder's work is determined by the diameter of the bore, which, in the present instance, will be a matter of 29 feet.

True, this dimension is one foot less than the external diameter of the Rotherhithe Tunnel but two feet greater than that of the Blackwall tube. On the other hand, the sum of the area of the cross section of the twin tunnels to be driven under the North River is 42 square feet bigger than that of the corresponding combined areas of the vehicular tubes beneath the Thames. This means that an increased volume of air will have to be supplied continually in advancing the shields in the new undertaking and in holding the water at bay while the sand-hogs do their work. The river bed of the Hudson in which the tubes will be formed is of a nature likely to prove exceedingly troublesome unless an exceptionally large volume of operative air is always at hand to provide the needful safeguards during building operations. The demand would be considerably reduced if the shields could be driven through a body of the stability of clay and gravel.

In order to proceed as rapidly as possible, the plan is to drive the two tunnels simultaneously from the opposite banks of the river; and to this end, there will be a total of four headings. The tops of the tubes, where they run beneath the fairway of the stream, will lie 60 feet below the surface of the river at mean low tide. Therefore, to neutralize the hydrostatic pressure that must be dealt with at the shields, there will be assembled on each shore a battery of compressors capable of supplying 25,000 cubic feet of free air each minute, at a maximum working pressure of 50 pounds to the square inch.

The adoption of the approved scheme was the climax to two or more years of study

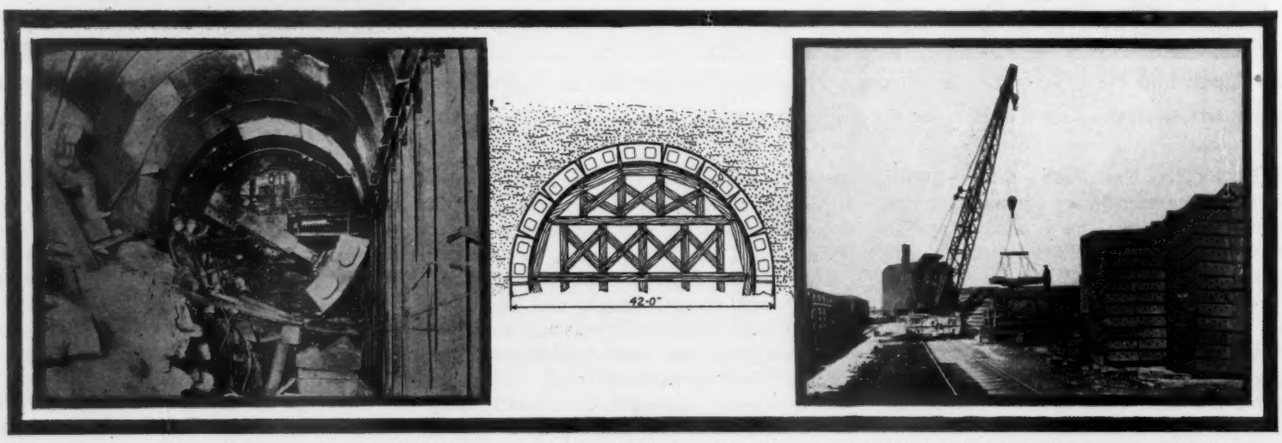


Fig. 1. On the left is shown a concrete block tunnel which was built in solid earth and not subjected to hydrostatic pressures. It is a much smaller structure than the concrete block tunnel proposed by General Goethals. Even though formed under favoring conditions, the unions between contiguous elements differ widely in character—some being snug, others gaping, and still others subject to sufficient compression to cause the neighboring surfaces to spawl. Fig. 2. On the right is shown the cast iron segments which will compose the rings of the tubes of the vehicular tunnels. The segments can be nicely machined so that these structural units can be bolted together snugly and rigidly. It is upon the strength of these built-up rings that the success of the tunnel driving and the permanency of the structure depend. Fig. 3. The center diagram illustrates how the imperfections in casting the concrete affects the union between adjacent blocks.

during which various methods were proposed. Twin tubes composed of a series of rings formed of cast-iron segments were decided upon by the New York State Bridge and Tunnel Commission and the New Jersey Interstate Bridge and Tunnel Commission only after their Chief Engineer, Clifford M. Holland, and his associates had carefully analyzed the other projects from every point of view.

The members of the New York State Bridge and Tunnel Commission are: Gen. George R. Dyer, Chairman; Messrs. E. W. Bloomingdale, McDougall Hawkes, A. J. Shamberg, Grover A. Whalen and Frank M. Williams, commissioners; Clifford M. Holland, Chief Engineer; Paul Windels, Counsel; Morris M. Frohlich, Secretary.

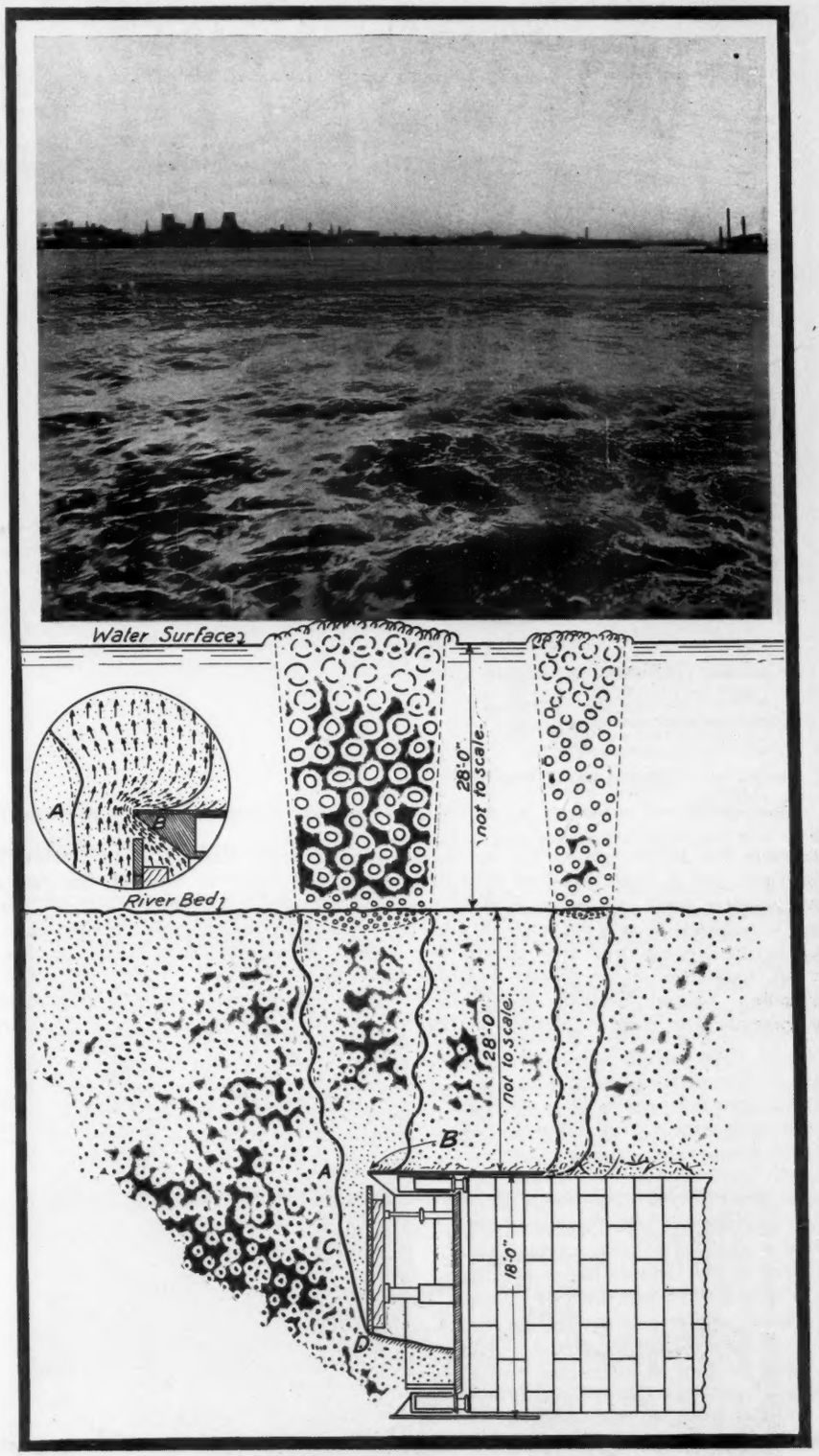
The members of the New Jersey Bridge and Tunnel Commission are: Weller H. Noyes, Chairman; Samuel T. French, Vice-Chairman; Palmer Campbell, T. Albeus Adams, Theodore Boettger, Thomas J. S. Barlow, Daniel F. Hendrickson, Richard T. Collings, Emerson Richards, Counsel; Charles M. Bacon, Secretary; E. Morgan Barradale, Assistant Secretary.

The competing proposal that has won the greatest amount of publicity provided for a single tube, 42 feet in external diameter, to be formed of concrete blocks, and to have two traffic levels with driveway widths each of 22 feet 6 inches between curbs.

This plan was found to be too revolutionary, and to involve constructional problems of an unprecedented character. But ultimate rejection was based upon the fact that provision was not made to bind the several units together so as to obtain a measure of rigidity comparable with that proved essential in the other subaqueous tunnels underlying the North and the East Rivers.

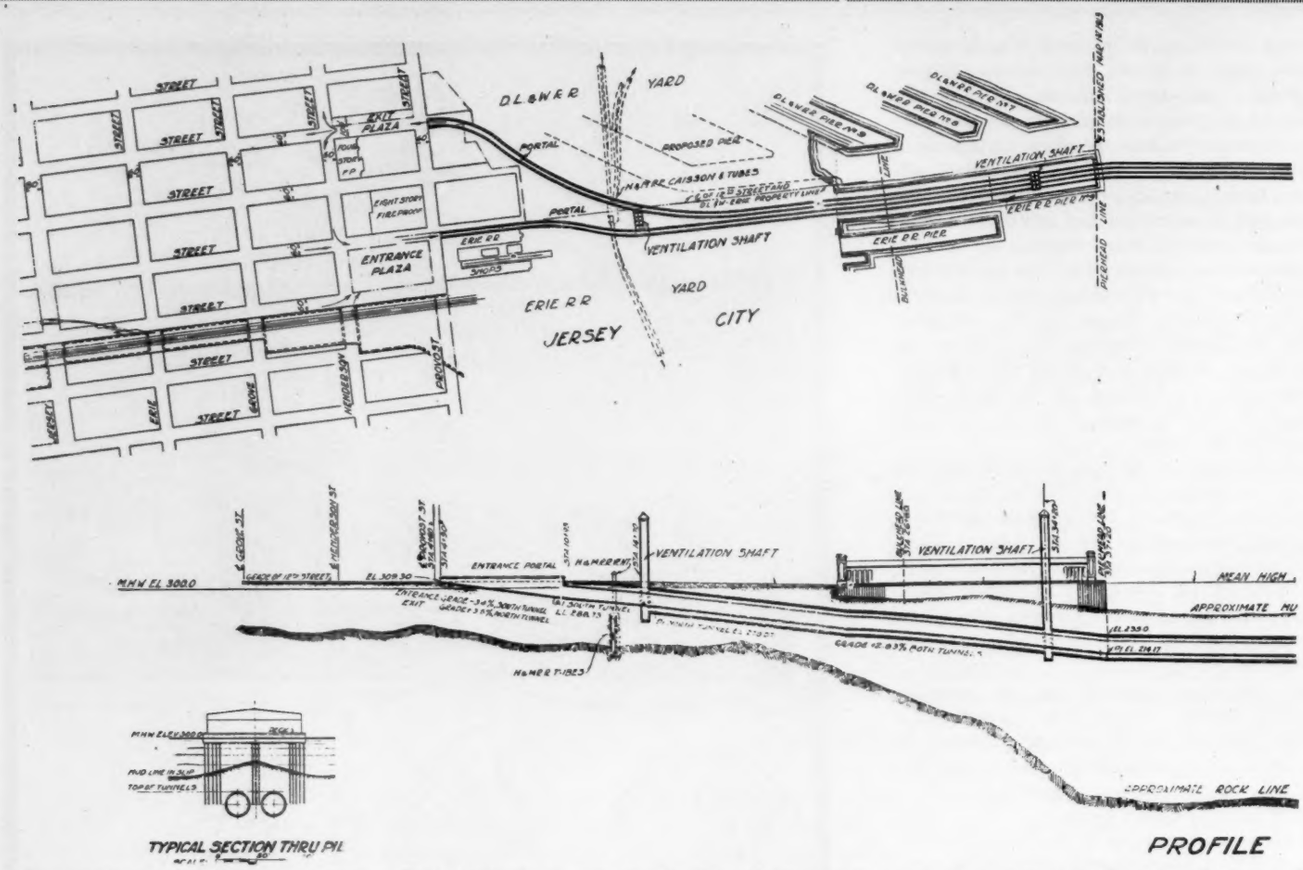
Experience gained in building 22 lesser tubes beneath these waterways has emphasized the advantages of a lining of cast-iron rings made up of segments bolted rigidly together. That is to say, the units of each ring could be brought metal to metal at their flanges and then drawn to a snug union by means of bolts; and the several rings, in their turn, could be similarly joined to their contiguous rings—thus forming a homogeneous tube of great strength and structural integrity. The interlocking concrete block design, on the other hand, provided only for longitudinal bolting of the *voussoir* elements between rings and counted upon a cement bond and enveloping pressure to bind together the blocks of each section or ring. The proposal apparently did not give heed to the difficulties encountered and the unsatisfactory results obtained in building by the same general method much smaller tunnels under conditions far more favorable than those existing in the river bed of the Hudson at the depth and along the line prescribed for the interstate under-water traffic artery. As Mr. Holland explains:

"The fundamental difference between the concrete-block ring construction and the cast-iron ring construction is that one ring of blocks cannot stand up without the support of the adjacent rings of concrete blocks, whereas each cast-iron ring is a complete entity and self-supporting."



Air escaping surfaceward from a tunnel heading that is burrowing its way under the East River. This agitation gives an idea of the volume of air that must be supplied continuously by the compressors to hold the water at bay. The diagram shows the condition at edge of shield when bubbles of air are passing through the overlying sand and silt and then to the surface of the water. In instances, where the escaping air has caused too great agitation of the sand or silt, a blow out has ensued which involves much danger to the men.

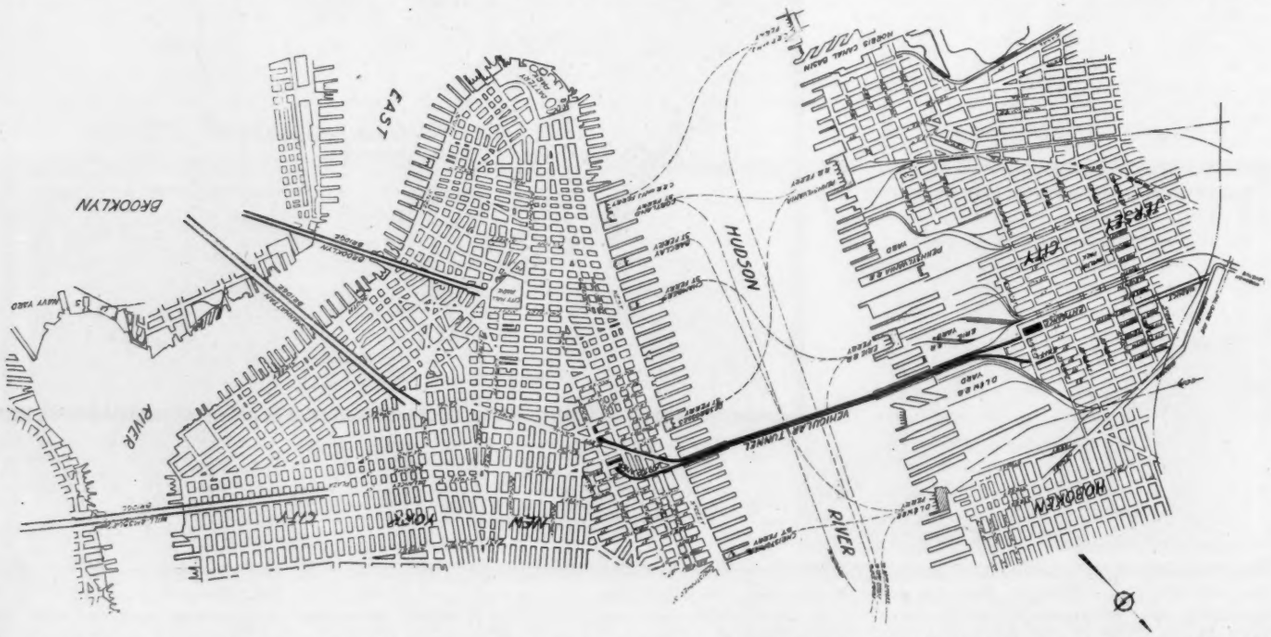
Mention has been made of the rejected interlocking concrete block tunnel plan mainly because its most outspoken sponsor has been Maj. Gen. George W. Goethals. His claim has been that millions of dollars might be saved by the substitution of concrete blocks in place of cast-iron segments, but the experts of the interstate commissions, after much painstaking analysis and research, failed to substantiate his figures. Further, in



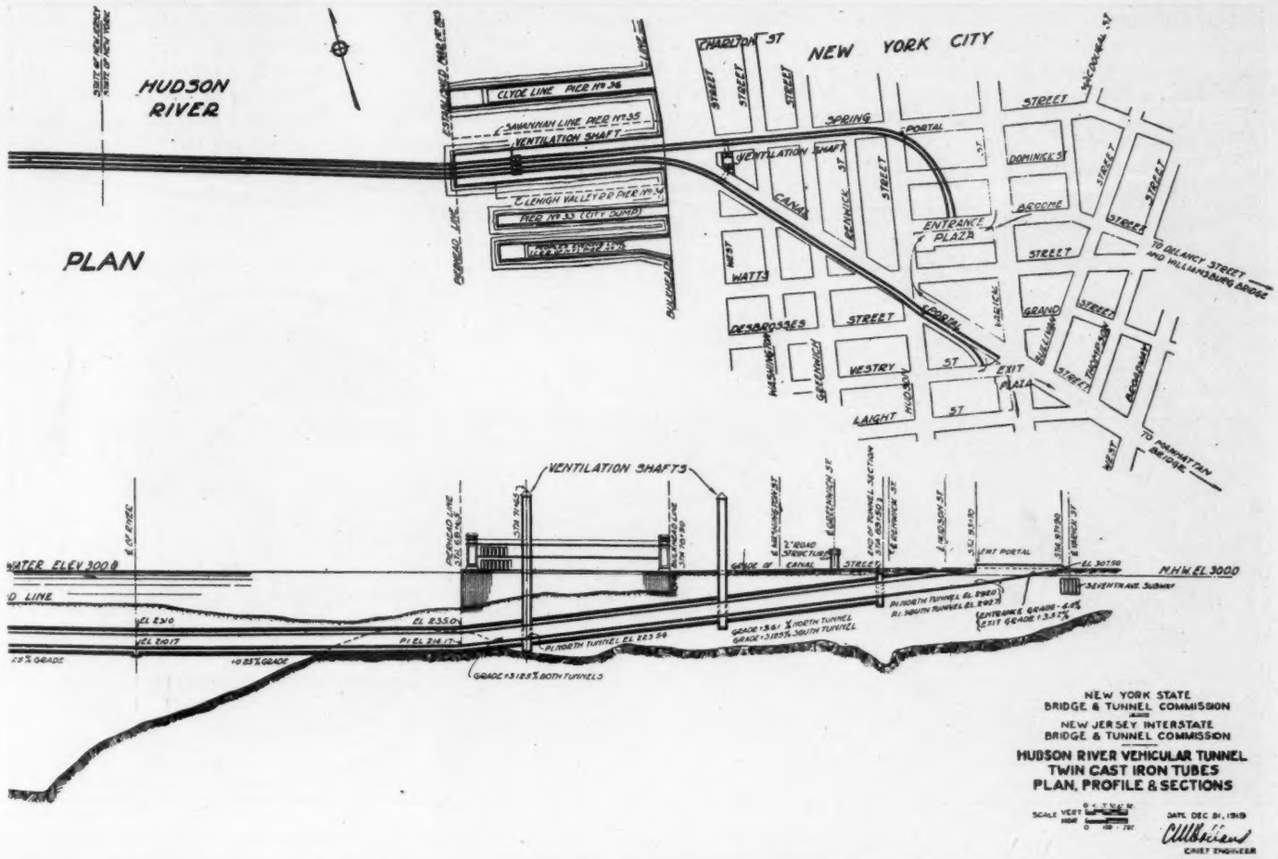
Plan, profile and sections of the Hudson River vehicular tunnels showing the elevation of the rock and mud lines in the river's bottom and the

dissecting the 42-foot project the engineers discovered that a single two-level tunnel of that diameter could not accommodate three lines of vehicles on each roadway—as promised in the proposal, and they showed that serious congestion at the portals would be inevitable. General Goethals acknowledged the correctness of these conclusions by later suggesting the building of twin tubes, each 36 feet 6 inches in external diameter, with single roadways 25 feet in width. Even so, the adoption of the concrete structure, for numerous reasons, remained too debatable for acceptance.

The two 29-foot tubes will each exceed by 5 feet 6 inches the diameter of the largest of the present railway tunnels running beneath the Hudson River, and this will afford sufficient room, inside of the concrete lining, for a roadway 20 feet broad from curb to curb and permit a two-foot treadway at one side for policing and other purposes. The roadway will allow for the passage of two lines of vehicles bound in the same direction—



The location plan of the Hudson River vehicular tunnel showing how the New York terminal will adjust itself to existing arteries of traffic. Note that the entrances and exits of both terminals are separated by several city blocks for the purpose of avoiding congestion. The relation of the Manhattan ends of the new twin tubes to the traffic lines of the East River bridges is clearly shown by this map.



mean high water level. The grade of tunnel at either terminal will not be greater than 3.6 per cent. The four ventilation shafts are also indicated.

one fast and one slow, and besides leave ample clearance between wide motor trucks and the largest of automobiles. The vertical space between the ceiling and the driveway will have a span of 13 feet 6 inches, which is high enough to meet all requirements.

Before settling upon the maximum dimension of the cross section for the dual route, the engineers gave months to investigating both the physical conditions to be met as well as the probable traffic demands likely to develop during the two decades following the opening of the tunnel for service. Traffic records of the ferries from which vehicles will be diverted to the under-water highway revealed extremely interesting figures showing the steadily increasing number of pleasure cars and motor trucks carried across the river, and subsequent observations brought out the fact that the growth in traffic tonnage has been greater than that indicated by the mere number of vehicles in transit.

This development has been along the line of added carrying capacity, and has been especially marked in the case of large power-driven trucks drawing goods to and from the remoter places like Newark and Paterson. The question, therefore, has been to consider all available data, give due heed to the trend of the Manhattan-New Jersey movement of vehicles, and then plot curves that would give a reliable approximation of probable conditions 23 years hence—thus taking care of changes during the constructional period.

Assuming the tubes to be ready in three

© Bachrach Studio, 1919.

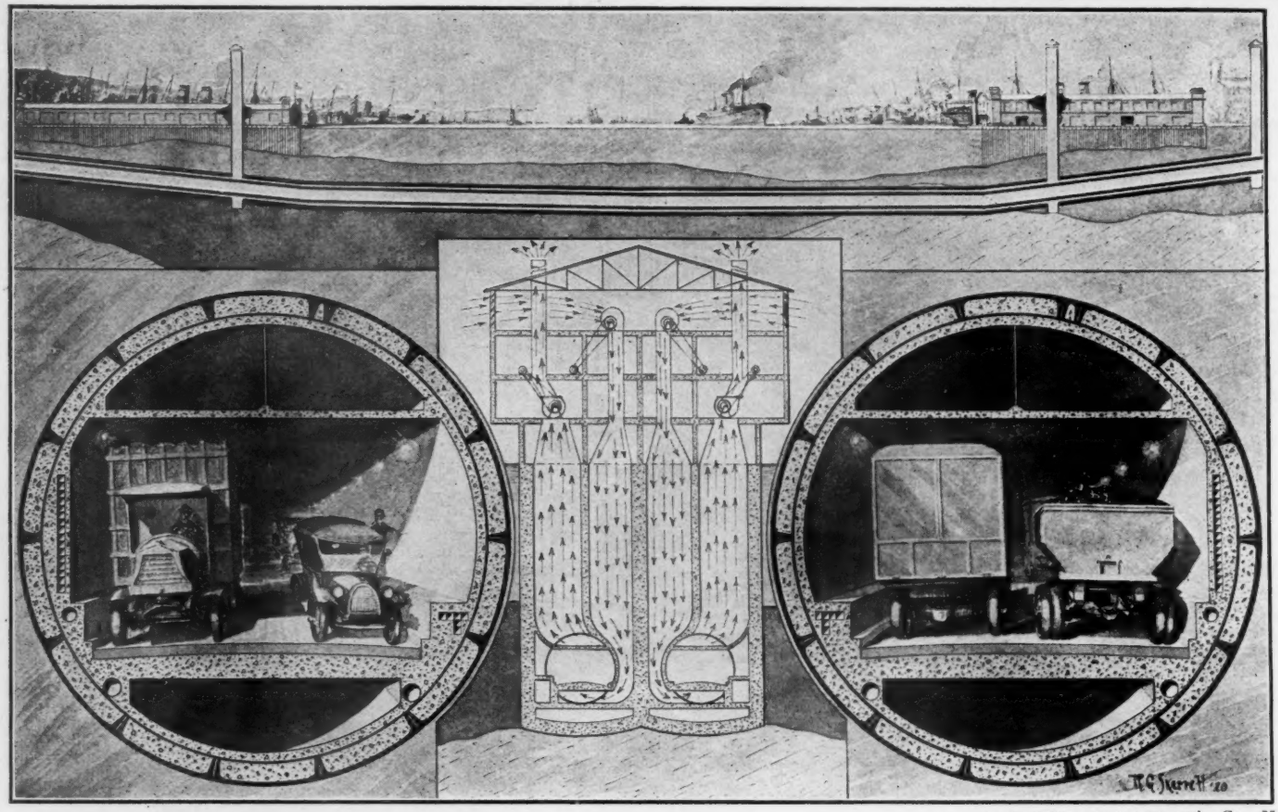
Clifford M. Holland.

Clifford M. Holland, was born on March 13, 1883, at Somerset, Massachusetts. He was graduated from Harvard University in 1906 and the day following the conclusion of his college career he reported for work in New York City in connection with the driving of the original Battery tunnel linking Manhattan with Brooklyn. Without cease from that time on until he was appointed Chief Engineer for the New York-New Jersey vehicular tube, he has devoted his efforts solely to subaqueous tunneling, combining an exceptionally wide practical experience with technical familiarity with every phase of this type of engineering. He has personally had to do with the driving of no fewer than 28 headings under the East River. In short his entire professional career has been centered in undertakings of this character. Because of his exceptional qualifications he was chosen for his present very responsible office.

years and a half, the estimated tunnel traffic in 1924 will be about 5,610,000 conveyances, a movement substantially identical with that now over the Williamsburg Bridge between Manhattan and Brooklyn. Ten years later, according to the calculations, the tubes will be expected to take care of 12,900,000 in the course of twelve months, while in 1937 full capacity of accommodation will be reached, when the daily average will total 46,100 vehicles—substantially 15,700,000 annually.

By that time, it is proposed to exclude horse-drawn conveyances from the tunnels during rush hours. One tube will be devoted to west-bound traffic and the other to east-bound service, and there will be a slow-moving and a fast-moving line in each of the routes. Heavy trucks will travel at a rate of from five to six miles an hour, while pleasure cars, etc., will be able to advance at speeds of from ten to twelve miles an hour. These velocities will permit a spacing between vehicles ample enough to avoid collision in the event of a sudden breakdown or stoppage ahead.

Perhaps a better idea of the part that the under-water highway will play can be gathered from the fact that 62 per cent of the motor conveyances from the down-town "five-ferry" group, fourteen per cent of the cars and trucks from the "six-ferry" group—most of them tapping 23rd Street, and 20 per cent of the heavy traffic now crossing the river on lighters, will seek passage via the new tunnels. Quite aside from the convenience to passenger cars,



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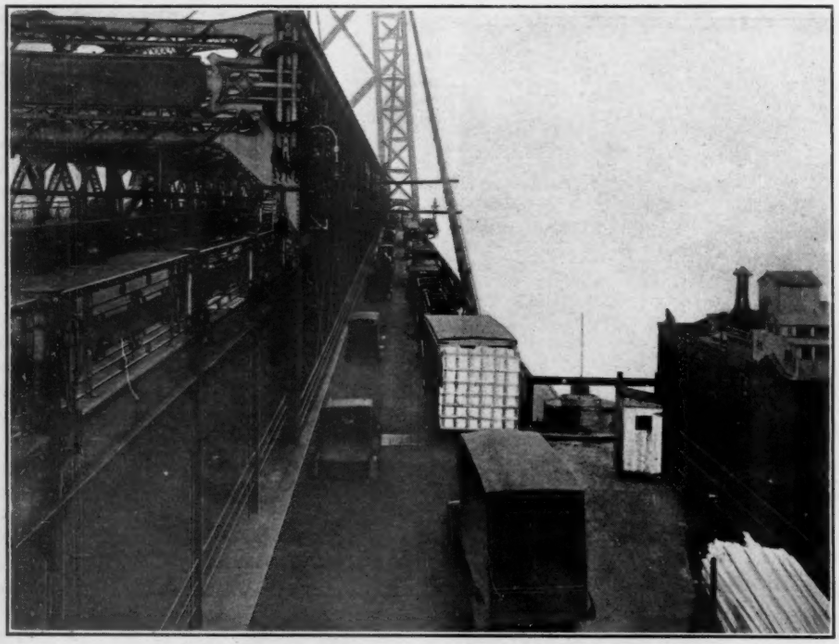
The upper drawing pictures the general emplacement of the New York-New Jersey vehicular tunnel as it passes successively through the different geological strata of the Hudson river bed. The central sketch shows graphically how the ventilating shafts will straddle and surmount the twin tubes as well as the way in which fresh air will be forced down into the viaducts and the vitiated atmosphere withdrawn at the same time. The flanking cross sections indicate the structural features of the tubes.



This picture is of a roadway 19 feet 11 inches wide upon the Williamsburg Bridge. This gives an excellent idea of the amount of lateral space between laden trucks and automobiles—the two lines of traffic thus stimulating the fast and slow streams of conveyances which will thread each tube of the vehicular tunnel, in which the driveway will have a span of 20 feet from curb to curb. Incidentally, the gradient in this case is substantially identical with the steepest slope that will have to be dealt with in the tunnel.

it should be clear that the twin vehicular tubes will permit of rapid and continuous tide of trucks transporting many millions of tons of freight in the course of a twelvemonth, and this without any regard to seasonal conditions or other circumstances which would have a bearing upon the availability of carriage by water.

The presence of so many automotive vehicles within the relatively restricted space of the subaqueous passages has called for the most careful planning to insure proper ventilation. It is essential that poisonous and distressing products of engine exhaust gases be diluted with fresh air and then removed fast enough to prevent ill effects upon persons in transit, the tunnel police, and any draft animals. No other vehicular tunnel affords a precedent upon which to base ventilating needs; and the experts have been obliged to study this vital problem *ab initio*.

The famous Rotherhithe tube has an interval of 1570 feet between its ventilating shafts installed to promote a natural movement of the air. As designed, the New York-New Jersey project will have four shafts straddling the twin viaducts, but artificial ventilation must be resorted to. One reason for this is that the two shafts nearest the thread of the stream—those rising through opposite piers—are separated by a distance of substantially 3,800 feet, or more than twice the stretch between the ventilating shafts of the London tunnel.

At the four shafts there will be installed a total of 65 electrically-driven blowers which will serve the twofold purpose of withdrawing the tainted atmosphere and of forcing below into the tubes a steady flow of fresh air. This volume will be large enough to completely change the atmosphere in the tunnels once every two minutes, if conditions require it. As originally estimated—and this in advance of laboratory tests—it was thought that the ventilating equipment should be capable of keeping the vitiation down to an average of three

parts of gas to each 10,000 parts of air in the tubes. Physiological studies carried out at Yale by the U. S. Bureau of Mines have proved that a higher ratio of gas can be borne for a considerable period, say three-quarters of an hour, without troublesome symptoms. Pleasure cars, even when traffic is densest, should not take more than fifteen minutes to make the run from entrance to exit; and a period of forty-five minutes is deemed sufficient for the heavy, slow-moving line while allowing an ample margin against interruption.

It has been authoritatively stated by Dr. Yendel Henderson, at Yale, that the exhaust of a gasoline engine contains no substance other than carbon monoxide which is toxic to any appreciable degree, and that the noxious CO upsets the physiological routine by combining with certain elements of the blood in a way to lower that vital fluid's oxygen-carrying capacity. According to the measure of oxygen so denied, a person is more or less unfit for physical exertion. When the amount of carbon monoxide in the air is too low and the length of exposure to it too short to induce headache, the tainted atmosphere may, for all practical purposes, be deemed harmless. During the experiments at New Haven, four parts of carbon monoxide in 10,000 parts of air did not cause headache after an exposure of an hour; and with six parts of CO the effect, if any, was commonly very slight. It took a mixture of eight parts of CO in the given quantity of atmosphere to occasion decided and protracted discomfort.

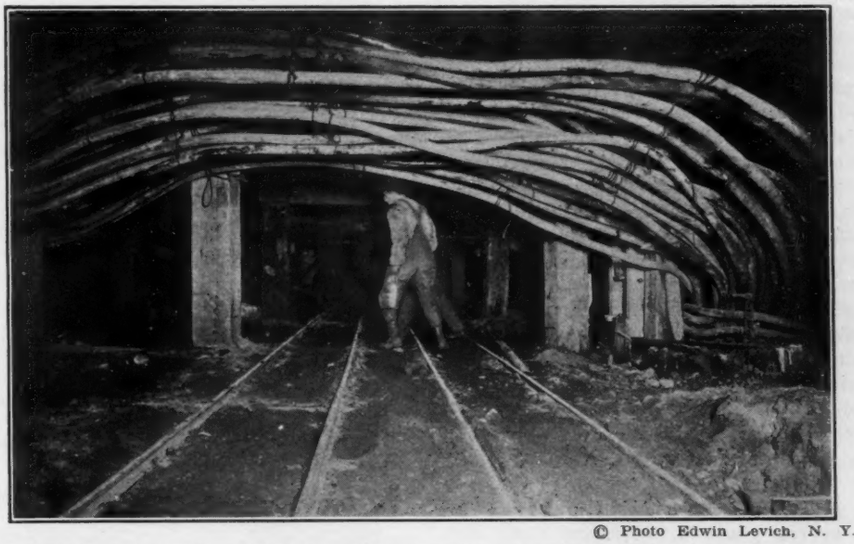
As the tunnel will be ventilated longitudinally, and the air will flow with suitable velocity to and from the several shafts, it will be impossible for any section to be contaminated by an excess of carbon monoxide long enough to bring about hurtful results. All that will be necessary to insure the welfare of even infants and invalids passing through the viaducts is an atmosphere containing an average of not more than four parts of CO. This means that the equipment for forced ventilation need not be more than 75 per cent the capacity believed essential a year ago. Accordingly, the cost of blower installations will be reduced to that extent. This is substantial evidence of the economic value of scientific research.

Energizing current for the fans will be obtained from public service power plants in either or both States, and by this arrangement the likelihood of a shut down will be reduced to a minimum.

As the cross section of the tube shows, ventilating conduits will occupy the areas above and below the traffic way, and the incoming fresh air will be distributed from the lower space and the contaminated air will be withdrawn through gratings in the ceiling leading into the upper ventilating passage. This arrangement is the outcome of tests made by the Public Service Corporation of New Jersey four years ago, when the proper method of ventilating a vehicular tunnel was studied by means of a model large enough to accommodate an automobile. These revealed that the measure of vitiation was very much less when fresh air was introduced at the bottom of the tube section and exhausted by way of the top. The explanation is simple; the hot gases tend to rise rapidly, and incoming fresh air similarly directed merely stimulates this movement and facilitates the flow to the suction gratings overhead.

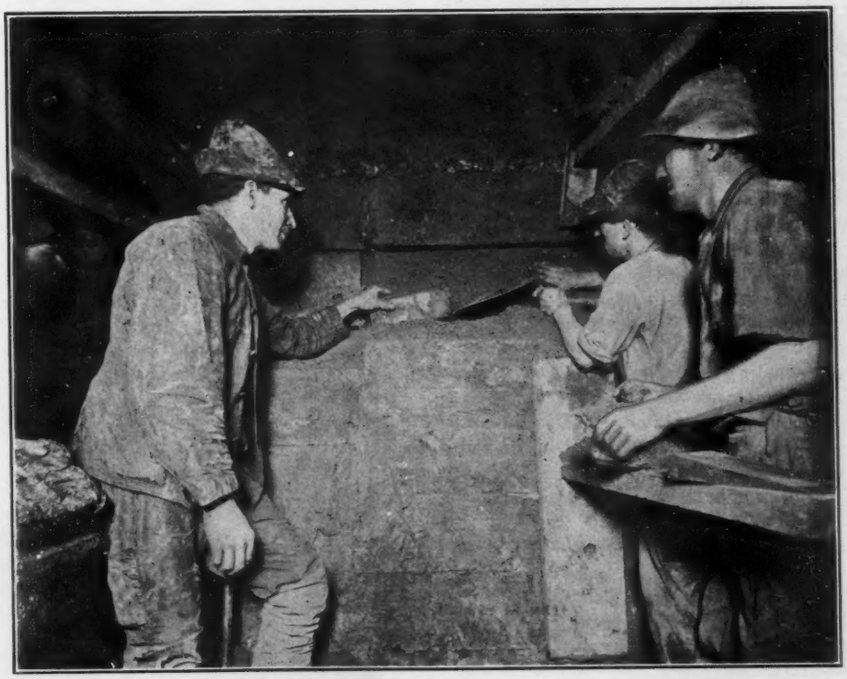
To the uninformed, it may seem that the choice of a 29-foot maximum diameter was influenced only by structural considerations and the requirement of a roadway wide enough for two lines of traffic. But, as a matter of fact, economy of ventilation figured conspicuously in the determination of the controlling dimension. In a tunnel of such length, and especially owing to the great interval between two of the ventilating points, it was essential that the sizes of the longitudinal supply and exhaust chambers or conduits should be so proportioned that they would permit of a fairly easy flow of the air and, therefore, avoid as far as possible any "wire-drawing" action which would necessitate more energy at the blowers.

Research disclosed that a 29-foot tube could be ventilated for much less money than a tunnel 27 feet in diameter. Here, at once, was found a way to reduce substantially the operative overhead. At maximum capacity, the accepted design will entail an annual ventilating charge of $280,000.00, while tubes 27 feet in diameter would call for a ventilating



© Photo Edwin Levich, N. Y.

No small part of the engineering problem towards the tunnel terminals will consist in successfully sidestepping mazes of electrical cables, gas mains, water pipes, sewers, etc. It is indispensable that none of these be destroyed or their service in any way impaired.



Courtesy of Transit Construction Commissioner, N. Y.

Sand hogs working under pressure in front of a shield where they are removing a breast board and clearing away the earth exposed. It is in this same careful way that much of the solid material of the river bed is excavated along the path of mud which if it appears to be giving way the breast board is replaced and wedged in position.

power outlay yearly of $529,350.00. Twenty-eight foot viaducts would consume $402,450 worth of current for this service.

It has been shown in connection with most of New York's big bridges spanning the East River that their traffic accommodations are very considerably in excess of their utilization, and mainly because of the inadequacy of the approaches which occasion vehicular congestion—thus slowing down the actual movement across these costly spans. Consequently, Mr. Holland and his associates have given the closest sort of study to traffic circumstances likely to influence the use of the vehicular tunnel. To obviate terminal congestion and to provide for the freest flow of conveyances traveling from New York to New Jersey and vice versa, the exit and entrance plazas on each side of the river are separated by an interval of two blocks. This will permit of eastbound and westbound travel associated with the two portals without inviting interference among these traffic streams. Further, the plazas will be placed far enough back from the shore line to leave unimpeded the vehicular tideway feeding to and from the busy docks. It is because of this arrangement that it will be entirely practicable to make the fullest use of the twin tubes.

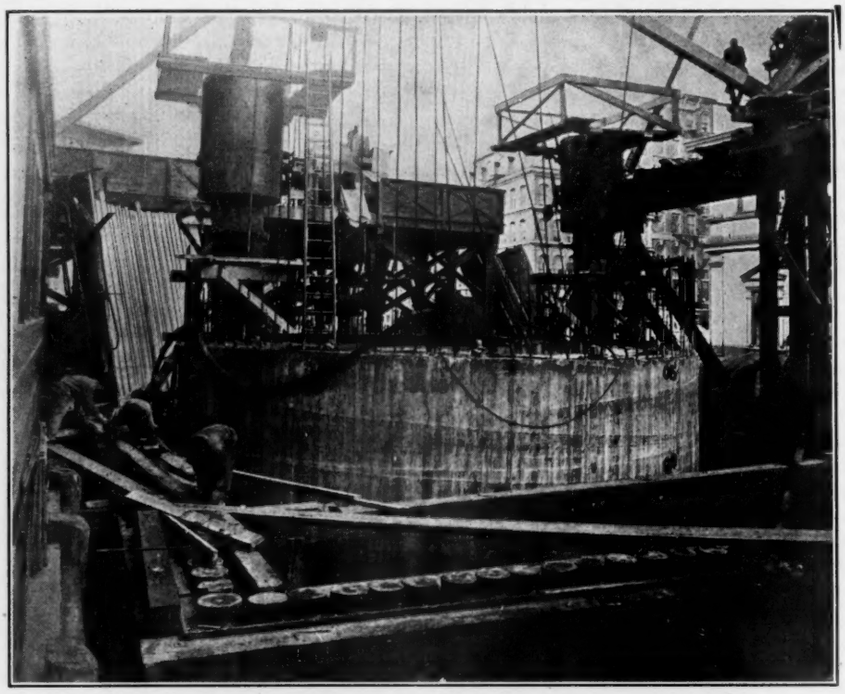
While the tunnel will lie at a depth sufficient to insure a protective covering of ten feet of mud between the top of the tubes and the Government Improvement Plane—a point 50 feet below mean low water, still the gradients at the terminals will not overtax the powers of draft animals or the drive of heavily-laden motor trucks. The greatest adverse grade for westbound traffic does not exceed 3.5 per cent., and that for the opposite movement is not more than 3.52 per cent. These slopes are relatively short and extend only from the portals to the points where the tunnel roadways merge with the street levels. To obviate crowding and to stimulate headway at these points of travel, the roadways will be broadened so as to permit of the movement of three lines of vehicles. The long adverse grade on the New York side extending from the pierhead line to the portals has a slope of 3.13 per cent.; and the corresponding section on the New Jersey end involves a climb of only 2.83 per cent. These gradients present no obstacle to the maintenance of the prescribed vehicular velocities.

For the sake of those that may not be familiar with subaqueous tunnel building by means of the shield method, let it be said that the procedure consists fundamentally in forcing a stout steel cylinder, bisected transversely by a metallic bulkhead fitted with air-locks and watertight doors, forward through the earth by means of hydraulic jacks. The advance rim of the shield is called the cutting edge, and the section to the rear of the bulkhead constitutes the "tail," within which successive rings are assembled and the tunnel progressively lengthened.

The hydraulic jacks get their footing against the last ring formed, and in this way drive the shield onward far enough to permit putting together the segments of the next unit section. Manifestly, the ring must be strong enough to support the thrust and the stresses set up by the multiple jacks employed in pushing the shield uniformly ahead into the obstructing river bed.

Forward of the diaphram or bulkhead, a working pocket is provided for the sandhogs by projecting a vertical barrier—using hydraulic rams for the purpose—to hold the mud at bay. This adjustable structure is termed the "breast," and is composed of a series of thick planks laid horizontally. By removing these carefully, one by one, starting at the top and working downward, the sandhogs dig away the earthy matter immediately in front, passing it rearward, and thus facilitate the onward travel of the shield.

Of course, it is realized that the advance tunnel section, the tail of the shield, and the excavating chamber are all charged with compressed air at a pressure high enough to balance the outlying hydrostatic pressure



In starting the headings riverward for the twin tubes it will be necessary to sink great operating shafts from strategic points on shore. This work will begin by sinking massive reinforced concrete caissons, and the execution of this will depend largely upon the availability of an ample supply of compressed air.

Some idea of the mighty forces at work in driving a subaqueous shield can be gathered from the flow of the mud rearward into the shield through a purposely opened door. Cars carry the mud back to vertical shafts by which the material is lifted to waiting carts.

and to hold the enveloping water within bounds. There is inevitable leakage outward into the mass of the river bed. Not only must this loss be neutralized by the battery of compressors ashore but it is essential that the working pressure shall be so nicely regulated that the escaping air will filter out at a moderate rate and not in forceful gulps. It is the latter action which is apt to violently disturb the overlying solid material and to induce a menacing, if not a fatal blow-out—the large volumes of liberated air being instantly succeeded by an inrush of water.

This explanation should make it clear why Mr. Holland wishes to have an overlying blanket of mud at least ten feet thick when burrowing under the North River; and if he could prescribe conditions he would insist upon a waterbed of clay or at least a much firmer substance than the stuff with which he will have to contend. The character of the bottom will call for the utmost caution at some points to prevent blow-outs. Aside from this, there will be an extremely troublesome stretch outside of the pierline on the Manhattan shore where the tubes will pass through the upper limits of a ledge of rock. Here, the sand-hogs will have to drill into the ledge and blast it away; and anyone familiar with subaqueous excavations will appreciate the difficulties and the dangers of this work.

Because of the changing getup of the river bed strata, and the fact that these are disposed unevenly in a vertical direction, the shields, during their onward movement, will be subjected to unequal frontal stresses, and these structures will, therefore, effect their progress by a more or less "snaking" process —their centerlines shifting vertically and horizontally within certain permissible limits. It is due to this unavoidable and intermittent deviation from the prescribed line of advance that the sustaining tunnel shell must be able to stand up against the shove of the hydraulic jacks, admit of adaptation to the sinuous course, and yet allow the segments and the rings to be linked so snugly together that leakage of water into the tunnel can be kept well within controllable quantities.

It is hard to imagine how these ends could be attained were it not for the employment of sturdy cast-iron segments having machined flanges which permit satisfactory unions through the agency of suitable screw bolts. The individual tunnel rings will have a longitudinal width of two feet, six inches, and there will be fourteen segments, each approximately six feeet long, and one key segment a foot in length forming a single ring. The various segments will be bound together by a total of 160 bolts of one and three-quarter inches in diameter. The spaces between the internal flanges will be filled with concrete, and this will be succeeded by an overlying concrete lining seven inches thick. In this manner, all outlying water will be pretty effectually prevented from finding entrance into the tunnel.

Making every allowance for construction outlays, the purchase of real estate, and variations in cost of labor and material, the entire project will involve an expenditure of $28,670,000, and this will be borne equally by the two states concerned.

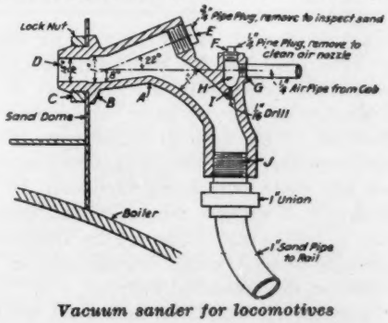
Income is based upon a scale of charges corresponding to the ferry tariffs for vehicular service. Mr. Holland declares that, with these rates applying, the tunnel cost will be amortized in eleven years from the date of opening, while at the conclusion of the second decade of operation there should be in hand a surplus to the credit of each State amounting to quite $33,633,500—this sum in addition to the possession of a twin tube subaqueous highway which will have paid for itself.

By virtue of this there will then be plenty of money at hand to start, without taxation, additional tunnels if there be need for them. The economic prospect is certainly a pleasing one; and the two commonwealths concerned may look forward confidently to the coming of a day in the near future—three and a half years after work is begun—when the water link of the North River will no longer constitute the one dominating medium of communication between Greater New York and neighboring New Jersey. The onward course of the pleasure seeker will be at a pace which is now impossible, and business concerns and the general public, vitally dependent upon the free flow of millions of tons of commodities, will not have to face the uncertainties which have so often prevailed in latter years.

A VACUUM SANDER FOR USE ON LOCOMOTIVES

THE ACCOMPANYING illustration shows an interesting device which has been developed by the Fryer Vacuum Sander Company, Tulsa, Oklahoma, and is now in successful operation on a large number of locomotives. As will be understood by reference to the sketch, the sand is drawn from the dome by the creation of a vacuum, instead of being blown by direct air pressure, as has been customary.

In order to apply the device to the locomotive it is only necessary to cut a hole of suitable size in the side of the sand dome when the nozzle of the sander is inserted and secured by



Vacuum sander for locomotives

a lock nut inside the dome. The lower end of the casting is fitted for a 1-in. sand pipe connection which is led into the hand sand pipe by the use of a suitable Y fitting a few inches below the hand sander connection to the dome. The installation is completed by the attachment at G of a ¼-in. air pipe from the control valve in the cab.

When ready for operation the sand closes the opening D into the dome and partly fills the horizontal passage at the left end of the casting, the upward slope of the bottom of the casing preventing it from flowing down the pipe by gravity. On the admission of air pressure at H, however, a stream of air is directed downward along the center line of the sand pipe connection through the 1-16 in. nozzle I, and a vacuum is created between the nozzle and the dome opening. The sand is thus drawn over the point A to be caught by the downward flowing stream of air below the nozzle and blown through the pipe to the rail. The device is said to provide complete control of the flow of sand up to its full capacity, which is the equivalent of a ¼-in. stream of sand, by varying the air admitted under the sander valve.

It will be noted that the sand is admitted to the casing through an opening restricted sightly below the size of the air pipe and the remainder of the passage through the sander itself, so that anything that will enter the sander meets no obstruction to its free passage to the rail, and the possibility of clogging is thus reduced to the minimum. The employment of the vacuum principle makes possible the elimination of traps or pockets in the sander, thereby greatly reducing the possibility of clogging or freezing in the device itself. Two cleaning plugs are provided at E and F.

AIR MACHINERY EXPORTS FROM UNITED STATES

The Bureau of Foreign and Domestic Commerce of the Department of Commerce has provided for publication the following table of exports from the United States of air compressing machinery, by countries, in the last month for which records are available, April, 1920.

Countries	*Dollars*
Belgium	6,270
Denmark	3,408
France	81,750
Italy	17,024
Norway	4,372
Spain	38,025
England	58,353
Scotland	680
Bermuda	562
Canada	24,364
Costa Rico	23
Honduras	95
Nicaragua	3,618
Mexico	11,944
Other British West Indies	400
Cuba	3,030
French West Indies	650
Argentina	1,226
Brazil	784
Chile	17,450
Peru	2,110
Uruguay	180
China	6,760
Kwantung	17,273
British India	8,033
Dutch East Indies	99
Japan	191,703
Australia	2,922
New Zealand	2,571
Philippine Islands	5,221
Belgian Kongo	1,865
Total	512,765

A. Burton Cohen has resigned as concrete engineer for the Delaware, Lackawanna & Western R. R. to enter private practice as a consulting engineer. His office will be located at No. 1, Madison Ave., New York. Mr. Cohen has been employed by the Lackawanna Railroad for a number of years, principally in the design and construction of bridge and railroad structures.

Actualities in Industrial Russia of Today

His Calling Gone, One Time Compressed Air Machinery Man Gets out of Distressed Land to Describe the Suffering and Chaos under Bolshevik Control, Presenting Facts, not Theories or Predictions—Workless Workers, Functionless Factories —Rampant Disease, Vermin, Starvation and Death

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THE FOLLOWING article has been procured from a foreigner who spent the greater part of his life in Russia, much of his education having been obtained in that country. For several years he was associated in Russia with a well-known manufacturer and distributor of compressed air machinery, but the chaotic conditions of transportation, finance and labor, not to speak of the seething political unrest, following the wake of Revolution in 1917 automatically put an end to this thriving business, (and up till the time of writing has prevented its resumption.) Our contributor none-the-less elected to remain in the country in the hopes that an improvement in economic conditions would set in within a reasonable length of time after the Revolutionists had been afforded an opportunity to put their political and economic theories to the test of practice. It was not for long that his former employers were permitted to continue paying his salary because their own enterprise was unable to survive; the Bolsheviki having deemed them unnecessary to the country's welfare and therefore closed them up. They were not even flattered to the extent of being nationalized as were many other industries. Our correspondent, like every one else, was forced to find other occupation in order to live, because it was now too late to leave the country, and therefore, he sought new employment as outlined in his article.

Recently (late Spring, 1920), a fortunate turn of events opened the way for him to leave Russia and he was not long in taking advantage of the opportunity. We were enabled to get in touch with him in Stockholm and to obtain this very interesting account of actual conditions as he experienced them. This communication reached us in the Swedish language, and has been translated in New York.. For obvious reasons we refrain from revealing the author's name, and also, where individuals are referred to, we have employed fictitious names because under present circumstances we should not feel at liberty to divulge their true identities without first being able to obtain their consent.—THE EDITORS.

TO OUTWARD appearance, the Russian *bourgeoisie* has become reconciled to the Red regime in their country, for almost without exception they have accepted employment with the Bolsheviki. Everyone must be employed by law, particularly males from sixteen to 50 years of age; but to work according to the usual conception of the term, simply is not done. Everywhere, in all enterprises, there are so many employees engaged, that such work as there is to be done could be finished with dispatch; nevertheless they prefer to sit around and smoke, flirt and discuss their love affairs; the subject of eating, and where and how one can negotiate the purchase of, or arrange an exchange for something to eat.

The educated middle-class school teachers, clerks and office assistants are having a very difficult existence, because the brainworker is very much underpaid. Salaries run from Rs. 5,000 to Rs. 8,000 per month. Such people therefore, endeavor to procure employment where, in addition to salary, they receive a daily allowance of from ¼ to ½ lb. of bread—and a Russian pound is only fourteen oz. avoirdupois. Such an enviable position can only be procured when influence is brought to bear by some one reputed to be a communist by conviction, and thoroughly loyal to the *Soviet* government.

Without the advantage of this special influence, one is forced to resort to the labor exchange, where every worker must be registered. But unhappily the chief function of these labor exchanges consists in disbursing the daily allowance paid to the so-called work-seekers, who also there consume the daily mid-day soup provided for them gratis. Ordinary day-laborers frequently register as applying for office positions, but as they usually are unable to write anything but their own names, their services are promptly rejected by any and all offices; they can then without any further exertion on their part continue to live at the expense of the state as "out-of-works," but nevertheless taking advantage of every opportunity to gather in very respectable sums by doing odd jobs on the sly.

Whenever an enterprise is in need of a really competent worker, the labor exchange is circumvented through the employer and his prospective employee coming to an outside understanding and mutually arranging to report simultaneously to the labor exchange; the former as desiring to employ a certain class of worker, and the latter as having located an available position with the former.

It is a matter of extreme difficulty for a foreigner, English and French in particular, to land a good job. To begin with, references from three Communists are required, and as foreigners do not associate with such, this condition is not easy of fulfillment. Moreover, foreigners are always open to espionage and are continually being victimized by informers. I secured my references through Boris's family, and supported by Dimitrieff's influence was successful in obtaining an appointment in a chemical factory.

This factory, which the Bolsheviki are trying to open, is to be absorbed into the ramifications of the former State Spirits Monopoly. Production has not yet commenced, because it was intended to change the location of the steam boilers; but they contemplated producing principally Epsom salt and saccharine. As, however, many elements essential to the production of saccharine are totally lacking in Russia, and also the available supply of common salt for converting into Epsom salt is extremely limited, this industry is for the present at a complete standstill, except for the fact that the entire force of laborers and office staff were maintained at full strength doing very little.

I, as an assistant accountant, was put on keeping the stock books and taking an inventory. This latter had not been taken since 1914, and we were not infrequently astonished by discovering how much had managed to disappear in the last six years.

My job was classified as one of so-called responsibility, and rated according to the first category with pay at Rs. 6,000 per month with extra allowance of three-eighths of a pound of bread daily, ten pounds of salt monthly (possibly to avoid the embarrassment later of actually having to start the production of Epsom salt) and one-half a fathom of firewood monthly. A full "fathom" of wood in Russia is a pile 7'x7'x14", the latter dimensions being the length of a stick. As I also took over the distribution of firewood to the employees, they were going to raise my pay another Rs. 2,000 per month and increase my bread ration to one-half pound per day, instead of three-eighths of a pound.

This factory had about 100 laborers on their payroll who worked only every once in a while at tearing down wooden structures and houses in the vicinity for the lumber, conveying it to the factory premises, where it was redistributed amongst the employees as firewood.

The laborer's working day was fixed at eight hours, and that of the office employees at six hours. Of the few factories still maintained in operation, production has ceased in about 90 per cent of them on account of lack of fuel, machinery, tools and, last and not least, raw materials of production. The workers in these plants are mainly occupied in electing *otryady*, or "flying columns" from among their number, to be sent to the so-called "Bread *Gouvernements*" (Saratov, Samara, Witebsk, etc.) with orders to purchase for the other workers in their plant, supplies of flour and cereals. If one is so fortunate as to boast the acquaintance of any one of these *tovarishtshi* (comrades), it is possible to acquire a few pounds of the delicacies he has brought along; of course the accommodating one will calculate several hundred per cent. profit for himself in return for his generosity, but even so it comes cheaper this way than buying such produce from dealers.

Wherever you go, very little work is being done; for instance at Poutiloff Works they repaired only eleven locomotives in half a

year, and in the last two months of this period, January and February, 1920, but two engines were made ready and these for their own use, because they were faced with the necessity of hauling provisions from Siberia for the Poutiloff Works' employees and workmen. The Oboukhoff Works are engaged only in repairing railway cars, no new cars are being built because the necessary raw material and coal for fuel are lacking.

For the same reason, all shipyards are at a standstill, and the new construction already commenced is now left standing in a half-completed condition, dilapidated and corroded with rust, there being no suitable paints available for applying a protective coat. The steam boilers in all factories are being fired with building lumber or with green firewood brought straight from the forests as soon as cut. In order to obtain fire wood, all wooden houses, fences and other structures in the vicinity of the factories are torn down and forests lying within an area of 20 *versts* (12 miles) radius from Petrograd are being felled, converted to fire wood and transported to the factories and immediately consumed.

Now that the Bolsheviki have rounded up and consumed all known accumulations of foreign supplies and stocks of raw materials, I do not hazard a guess as to how they shall be able to carry on in the immediate future. Everything seems to be lacking, nothing, absolutely nothing remains. I never could have believed that a country could be stripped so completely bare as has been accomplished in Russia within the relatively short time of two years.

It is quite impossible for any mortal to obtain sufficient to eat on salaries of five to eight thousand roubles per month, because beyond the daily ration of three-eighths of a pound of bread and a boiled soup, prepared from frozen or decayed cabbage, quite innocent of any grease or fat content, and thoroughly unappetizing, nothing is supplied on ration cards. Laborers and Soviet employees discharging responsible duties are allowed in addition to the foregoing ration from one-eighth to one-half a pound of bread extra and for dinner are provided with a cereal dish and if in addition to that one is furnished with salt and firewood one then becomes an object of universal envy. For instance, in Pavlovsk I was able to exchange six pounds of salt for 40 pounds of potatoes, but there are very few individuals placed so advantageously. The majority have only their salaries to live on. Before Mr. Malzeff was able to obtain a position in the chemical factory where I was employed he had only his salary to live on and was not allowed extra rations. In order to exist he had been forced to sell all of his valuables and all of his furniture except the bedroom pieces.

On Sundays and also at times on weekdays, the ladies of the *bourgeoisie* are to be seen sitting in the market places and offering for sale their worldly possessions, such as precious stones, watches, china and porcelain, furs, clothing, and other valuables, all of which are purchased exclusively by soldiers, sailors, peasants and *kommissars*, who

Specimens of Worthless Bolshevik Currency.

Above are the obverse and reverse sides of Bolshevik one and two rouble currency tokens in circulation in Russia today. This money is scarcely worth more than the paper on which it is printed. A translation of the legends on this money is as follows: "Proletariats of all countries unite. Token of settlement of the R.S.F.S.R." (Russian Socialist Federated Soviet Republic). The lower lines read: "Circulation on equity with credit notes is obligatory." It is a curious circumstance that the initials of the name of Soviet Government are the same in both the Russian and English languages.

pay exorbitant prices. The sellers then go around and spend the proceeds with the so-called "marauders" (or brokers and dealers in produce.) They obtain rye flour at 450 roubles; white flour at 800 roubles; butter at 8,000 roubles; bacon at from 2,500 to 3,000 roubles; bread at 350 roubles; potatoes at 180 to 200 roubles; all prices are per Russian pound of 14 oz. avoirdupois weight. A salt herring now costs 500 roubles; one egg 200 roubles; 25 cigarettes from 250 to 300 roubles; ⅛ lb. of *Mahorka* 300 roubles.

Mahorka is the vilest conceivable grade of tobacco, consisting principally of the woody and fibrous portion of the tobacco leaf that remains after the tissue has been stripped off for making the better grades of cigarette tobacco, etc. The Russian peasant and worker is very fond of wrapping this *Marorka* in a section of his daily newspaper making a *Tsigarshtshik* about 6" long. I understand that the printer's ink is supposed to impart a particularly delicious flavor to the smoke.

In order to live with any semblance of comfort in Petrograd at present, an individual requires a minimum income of from 30,000 to 40,000 roubles a month, but even so his appetite will never experience a sensation of complete satisfaction nor will he be able to keep up his physical strength.

One always goes around with a tired, exhausted feeling, because what all is one not called upon to do after being relieved at four o'clock from the Soviet job? Firewood has to be cut, and in my case, carried up to the sixth floor; then there is the water to be carried upstairs because on account of the poor pressure in the city water pipes, the water only reaches the third floor. In our family we had the good fortune to live in a house where the water pipes had not yet been burst by the frost, but in all neighboring houses it was necessary to carry up the water all the way from the street. When there is snow and ice to be removed from the streets, the tenants of the apartment houses are forced

to do this because *dvorniks* (janitors) and door keepers have been abolished by decree and are not permitted to exist in any house; but where such are found in spite of the decree, then the house committee is heavily fined and the *dvornik* is impressed into public labor.

No buildings are being repaired or maintained in condition, there being neither labor nor materials available for this purpose. It is, therefore, not surprising that buildings have depreciated to a very unsanitary condition and I have actually been in houses where the drainage pipes have been burst by frost and the contents poured down the stairs in a cascade; but nevertheless these dens of pestilence continue to be occupied by human beings. When the thaws commence things are certain to become much worse.

No individual is permitted to change his place of residence without the consent of the lodging committee, which is incorporated in the Council administrating every city precinct (*rayonny soviet*). One room is allotted for an individual and so my parents with a family of three, who occupied a five-room apartment were forced to take in two sailors as lodgers. Electric light fixtures, lamps and chandeliers may not be removed, these being considered the property of the house, even when the tenant has acquired same personally at an expense of thousands of roubles. This very thing happened to M. Dimitrieff, who is now living in an old office premises. As things are, no one attempts to move, there being in addition to the foregoing troubles, a great scarcity of lodgings, due to the fact that almost all wooden houses have already been torn down and used as firewood; and also the luxury of moving costs a small fortune of from 20,000 to 30,000 roubles.

As far as wearing apparel and foot wear are concerned, it is almost impossible for the average individual to swing sufficient capital in order to make new purchases. A pair of lace shoes manufactured by "Skorokhod," workmanship miserable, can be obtained at the market place through sailors at from 12,000 to 15,000 roubles a pair. Overshoes containing more tar than rubber, cost from 9,000 to 10,000 roubles a pair. Sailors seem to be amply supplied with such articles as they are looked upon as the "guardian saviours" of the Revolution, or as Trotsky says, "The Flower of the Revolution." Therefore, they enjoy special privileges and are well taken care of.

In the month of February, 1920, the "Skorokhod Shoe Factory" produced only enough shoes to enable them to negotiate an exchange for overshoes for themselves with the workers of the "Treugolnik Rubber Factory."

The Skorokhod Shoe Factory referred to was the largest mechanically equipped shoe factory in Russia. It was fitted throughout with American shoe machinery and produced formerly a grade of shoe about equal to the old $5 shoe of 1913. The "Treugolnik" was one of the largest manufacturers in Russia of rubber goods, pneumatic hose, automobile tires, etc., employing many thousands of hands. The quality of the Treugolnik Rubber Goods was famous throughout the World and known in Europe wherever compressed air was used.

Of all the industries in Russia, the state plant of printing and engraving reaches the greatest degree of efficiency, and is working to full capacity. Here the money or *leninki* is produced. Operation goes on day and night and printing proceeds without interruption. The workers in this plant are shown every consideration.

No money is now prepared in denominations of less than one rouble and the following notes or "tokens" are turned out:

Rs. 1, 2, 3, 5, 10, 15, 25, 30, 50, 60, 100, 250, 500, 1000, 5000 and 10,000.

Copecks no longer are in circulation, or at least in rare instances, because the cheapest article is a newspaper which costs two roubles or a ride in the street car which costs three roubles. The peasants in the country refuse to accept "money" in payment for their wares. They already have acquired whole chests full of paper money and finding it to be utterly worthless, they now are only willing to enter into exchange transactions so that they can receive in return for their produce such articles as old clothing, articles of gold or silver, linen, shoes, over-shoes or boots, salt, etc.

Hackmen (*Isvostschiki*) are exceedingly scarce. I do not believe there are more than 100 in Petrograd, and they will not consider any trip under 500 roubles. A trip from the Nikolai Railway Station to the Wassily Ostroff costs 3000 roubles, and if one has any luggage larger than a hand bag, an extra 2000 roubles per piece is exacted. (The distance mentioned would probably be between four and five miles.)

A truck driver (*lomovoy*) charged us twelve thousand roubles to haul our luggage from the Vassili Ostroff to the Finnish Railway Station. (This is about two miles and a half). Horses are universally in a half starved condition, so drivers limit a load to 35 *poods* (a *pood* being 36.1 lbs. avoirdupois) and even then it is not unusual to see a horse suddenly give up the ghost, quietly lying down on the street never to rise again. The meat of such an animal can be sold for from 300 to 400 roubles a pound (of fourteen oz. avoirdupois weight) and is in great demand. Dogs and cats, as well as the pigeons formerly so common in Petrograd, are no longer visible, either on the streets or in the houses. The animals have all been killed off, because it was no longer possible to feed them. Possibly the pigeons have wisely transferred their residence to the so-called bread governments, having found that a living no longer is to be picked up in Petrograd. Who knows?

Nevsky Prospekt, once Petrograd's pride, is now nothing but a country road. All shops have been closed and the windows sealed up with boards; the wooden paving blocks have long since been torn up (for fuel) and have not been replaced with anything else. The sidewalks are crowded with degenerate loafers supposed to be soldiers, or *Soviet* employees. The finest buildings have been given over to and are occupied by various governmental institutions. As an example, the Singer Building, at Nevsky Prospekt No. 28 (formerly the property of the Singer Sewing Machine Company) has been converted into a soldiers club. The American Consulate, as well as the Russian English Bank, which were formerly located in this building, have been thoroughly plundered and their archives distributed to the four winds.

All foreign embassies, as well as banks, have also been looted and the premises are being used as barracks. Such business establishments as those of Elisseyeff Brothers, George Bormann and Mertens, have been out of existence for more than two years. They were requisitioned bodily, lock, stock and barrel.

Their premises have been converted into the so-called *Gorodskiye Prodowolstvolawki* (municipal food shops) and present pictures of desolation and filth. The former inventory of these establishments has vanished from sight, without having been of any benefit to the greater mass of humanity, but the expression has already become proverbial that "he lives like a *Kommissar*," or "she goes around dressed like a *Kommissarka*." The latter, one can see wearing the most exquisite astrakhan or seal-skin jackets.

Elisseyeff Brothers was a large general grocery establishment; the finest in Petrograd. George Bormann was a world famous manufacturer of chocolates and confectionery. Mertens was a famous furrier who dealt in only the finest and most luxurious grades of fur. These firms were all caterers to the former aristocracy and in fact, to the Court.

Along the entire length of the Nevsky Prospekt (Petrograd's Fifth Avenue, and about four miles long), there are not more than ten tiny little shops still open, in the main owned by Jews, and where such small necessities can be procured as saccharine benzine (75 roubles for a very small bottle), hair pins (150 roubles for ten), flowers, Eau d'Cologne (3,000 roubles a small bottle), etc. All of the remaining space and former business premises serve as warehouses for office and private furniture which have been requisitioned; and any proper Proletariat is permitted to go to these places and fetch any furniture he considers he needs.

It is typical of the times to note that every "elegant" Russian must have a writing desk, whether he knows how to write or not, and preference is shown for the so-called American roll-top variety, wherefore, this type of furniture is in exceptional demand.

The *Gostiny Dvor* is closed and abandoned; quite empty.

The *Gostiny Dvor* was a compound of arcades occupying an exceptionally large city block. It was given over to small shops, good, bad and indifferent. These shops were owned principally by Tartars, Armenians, Jews and other non-Russian traders, although there were some old out and out Russian shops as well, such as for instance, the famous old firm of furriers of Odnouzheffsky, who had been in the same locality since 1825, and the more aristocratic firm of Mertens had its original beginning in the *Gostiny Dvor*. Also many cotton spinners including the Marozoffs of Moscow had retail shops in this compound.

Where the entire contents of the former shops of this section have vanished is a subject unknown to any one. They simply are said to have been "requisitioned."

The only bank remaining in Petrograd at the present time is the so-called "Narodny Bank," or Peoples Bank. This has headquarters in the former State Bank Building. There are four branches in the City located in the former premises of the Azoff-Don Bank, International Bank, the Bank for Foreign Trade and the Union Bank (Soedinenny Bank.) These are known as Branches I, II, III, IV, of the Narodny Bank. The other bank buildings have been taken over for a great variety of Government and semi-Government institutions, as for example, the building of the Junker Bank is now a Communist club. The Wawelberg Building is occupied by the Administration of the Murman Railway; the Siberian Bank Building is an Information Bureau—where no information is obtainable. The branch of the National City Bank of New York is a barracks.

Street cars were still running when I left, but most of them were broken down, and of the former 800 motor trams only about 100 are able to maintain operation; the balance have been dissected to provide necessary spare parts for those few remaining in anything approaching running condition. The car barns are now full of abandoned car bodies which are lying around by the hundreds. How long the last surviving cars will be able to maintain operation, I do not know, but the way things are now, there are usually about 150 passengers riding in, on and around a car originally constructed to accommodate a maximum of 50. When continually subjected to this degree of overloading any tram car can be expected to hasten towards its ultimate end.

Only 50 of the available cars are allotted to passenger traffic; the balance are used as city postal cars and as municipal freight carriers. No more trams operate on the Nevsky Prospekt; one terminus is now near the general staff building and if one desires to go farther than this, it is necessary to go on foot to the Mikhailovsky Square, that would be about a mile and a half or to Znamensky Square, about three miles, where another car can be found. The street cars operate only from 9 a. m. to 6 p. m., and on Sundays and holidays there is no service at all.

The railways are almost at a stand still. At the present time there are only two passenger trains a week between Petrograd and Moscow and they take from five to seven days for the trip. This formerly was a ten-hour run, being about 400 miles. To travel on these trains a special permit is required in order to obtain a ticket and there is only one class of accommodation where there were formerly three classes. If fortunate, it might so happen that you land in a first-class compartment, but if you are out of luck, you may end up in a *tepluschka*, a freight car with a little iron stove, for which there is usually no fuel, set up in the centre. Boards are then built around the sides to serve as bunks. The printed inscription on the outside of the car surviving from bygone days of military preparedness, announces that this car will hold 40 men or six horses. This quota is usually far exceeded as far as human passengers are concerned.

It was officially announced that passenger traffic had been cut down to this extent in order to facilitate freight movement, but the fact remains that shortage of rolling stock was the real underlying cause; and the available equipment is in such a miserable state of repair that the time is not far off when the railways will no longer be able to even keep up a semblance of operation and transport will cease entirely.

Post and telegraph continue to operate within the confines of the internal Empire, but foreign countries are shut off altogether. This internal traffic is very slow, and an urgent telegram handed in at Moscow may be delivered in Petrograd through the local Post Office three or four days after it is handed in. No postage is required for ordinary letters and the quality of service rendered is in keeping. Registered letters cost three roubles and these usually are delivered.

Last Winter electricity for lighting was supplied only two hours a day, between seven to nine in the evening, and as neither kerosene nor candles were obtainable, the good citizens could either go to bed early, or sit around in the dark. Hotels and restaurants no longer are in existence, and the would-be traveler must seek refuge with friends or relations, but if he is blessed with the distinction of being an official guest of the Government, he is put up in either "Smolny," a former very exclusive school for young ladies of the aristocracy or in the Hotel Astoria, (*Soviet* Headquarters) and where nothing is lacking. Under these circumstances, it is not difficult to treat the unsuspecting visitor to impressive visions of "Potemkin villages."

Potemkin was a resourceful general, enjoying the favor of Catherine the Great. Upon learning that his imperious sovereign contemplated a trip to the Crimea, Potemkin laid out the itinerary for the trip and secretly ordered model villages to be built along the route. As the trip progressed, Catherine would be shown an apparently flourishing village, where they would put up for the night. The travelers would then set out on the following morning by a wide detour; meanwhile the model village was promptly torn down and moved ahead a few miles, set up a little differently, and held ready for insection upon arrival of the caravan. This deception was repeated several times. According to historians, Catherine was very much impressed by discovering this hitherto unsuspected prosperity throughout her domain and Potemkin's popularity went up accordingly. The Bolsheviki do not seem to have studied this part of history in vain.

The former restaurants "Medved" (The Bear) and "Pivato's," have been converted into public kitchens, and are ghastly with filth. The Hotel Europe is an orphan asylum and kindergarten.

Automobiles are almost conspicuous by their absence, and such as are still in service are only at the disposal of very high *Kommissars* and even then are in semi-defective condition.

All theatres are working full blast, and doing a tremendous business. Seats cost from 125 roubles up, and at the Mariensky all seats are permanently taken up by Communists of high rank, so that mere mortals are never so fortunate as to obtain admission, unless, just as in the former days of the Imperial Government, it is possible to procure the influence of some one of powerful position—with the exception that your protector will now possibly be a letter-carrier, whereas formerly he had to be at least a general. The audiences are mostly made up of sailors, soldiers and their feminine appendages. The women are loaded down with jewelry, and the new Mariensky Theatre frequenters attempt to ape the brilliant audiences that formerly thronged the building.

Apropos of vermin. It is said in Russia that "the newest and most malignant internal enemies are the vermin," and no truer word was ever spoken than by the man who first coined that sentence. Tram cars, railway cars, theatres, prisons and hospitals swarm with them and people are dying by hundreds of thousands on their account. In February of 1920, 65,000 died of spotted typhus in Petrograd. A hospital nurse personally known to me, told me in despair that the hospital where she worked was so over-run with vermin that it almost seemed as if she could feel them under her feet when she walked across the floor. There are even cases of record where people suffering from inflammation of the lungs have been taken to hospitals, there to become infected with the dreaded spotted typhus! For the time being the *Soviet* Government is confining its efforts to fighting this new peril with decrees through which they proclaim that the only way to exterminate the enemy is through meticulous cleanliness! But how is one to conjure up this degree of cleanliness, when such a thing as soap does not exist?

At the time we left Petrograd, not only "spotted typhus" was epidemic, but hunger typhus, small pox and cholera as well. Patients suffering from these diseases were transferred to isolation barracks mostly to die, a mortality rate of 80 per cent. in such cases has been estimated, because there are no longer any kinds of medicines or disinfectants available. All surgical operations are carried out without the aid of anaesthetics, neither chloroform nor ether being obtainable. In addition to that is the unfortunate circumstance that all physicians, and in particular those from the Baltic provinces, are doing their best to get out of Russia. The Government has already taken steps to prevent a doctor from leaving his place of residence, without first obtaining special permission, under pain of drastic penalty.

Corpses of those who have died in barracks are transported to the burial grounds in large motor trucks, which carry from 30 to 40 coffins at a load. They are then interred in great common graves. People who died in their own homes are transported by their relations to the burying ground, either on small

hand carts, or in Winter on children's sleds, because hearses ceased to exist long ago. The undertaking business was first nationalized by the *Soviet* Government and then abolished because the regional *Soviets* claimed they could spare no horses for such luxuries as funerals. The poorer classes, such as former millionaires, bank directors and generals are even brought to the burial ground in rented coffins and these coffins must then be immediately delivered back to the rentor, upon arrival at the grave.

The passport system has been re-established and is even stricter than it ever was during the days of the Imperial Government. All people claiming Russian citizenship, or being unable to deny it, are compelled to report to their district *Soviet* and a new *"Sovietsky"* passport is then issued to them. All others, that is foreigners, must report semi-annually to the foreign section of *Kommissariat* of the Interior and each time they are re-registered. In addition to the ordinary passport, males from the age of 18 to 50 years are required to carry a special employment certificate (Udostoverenie Mesta Sluzhba) in which the record of the place of their employment is kept. If unable to produce this particular "pass" they are considered as being "out-of-work" and are then forced to accept employment at public work. Doing "public work" consists of cleaning out barracks, municipal stables, public baths, etc., digging so called common graves and burying corpses.

Such *bourgeois* as have not accepted the doctrines of the Reds, like former large merchants, bank directors, generals, priests, etc., and like our former lawyer friend, Mr. Popoff, are carried on a special register and are considered as hostages; these unfortunate beings can expect summary arrest without cause at any time, and until recently this was followed by execution before a firing squad.

Happily the death penalty has at last been abolished after thousands of unfortunates were the victims of this policy. Now innocent people of this type are only required to sit in prison and become infected with every variety of contagious disease and thus expire, but they may no longer be shot.

Traveling back and forth to and from foreign countries is no longer permitted because all frontiers have been closed and declared in a state of war. Any particular party leaving, or being allowed to leave the country must wait until such time as the Russians and the Finns are able to reach an armistice, then the travelers are conducted across the frontier.

Petrograd has been policed for some time by girls of from 17 to 25 years of age. Male militiamen are rarely seen because all able-bodied men have been drafted into the Red Army. It is a sight not altogether void of humor to behold half a dozen doughty *Militsionerkas* with army carbines slung over their backs, driving before them a bunch of from 30 to 50 husky men headed for the sinister Gorokhovaya, No. 2. Running down speculators is a leading passion of the Bolsheviki, but it is to be recorded with sorrow that the worst offenders in this direction are frequently to be found amongst their own kind, such as unimportant *Kommissars*, sailors and factory workers originally sent by their own organizations into the provinces in order to obtain produce but who then refuse to relinquish any part thereof, without being assured a personal graft of several hundred per cent.

These rascals are to be seen selling their illicit wares in the open market places. The Bolsheviki fear to take any steps for stamping out this practice because of the ever constant danger of precipitating an uprising. It is not surprising therefore, that these usurers are always well supplied with money and are able to acquire anything the heart desires. Another well-to-do class is made up of skilled workers who have specialized on some particular job and receive a daily wage often of as much as from 800 to 1500 roubles.

All schools are free in the sense of being gratis, but the Russian peasant as he is, is so suspicious that he declines to send his children to school. To combat this, a decree has been promulgated rendering it obligatory for all citizens between the age of fifteen to 60 years to know how to read and write, but this order the same as others like it, is universally ignored and the masses remain just as uneducated as ever, only they are by far more rough and cruel. The way things are arranged, it is even possible for any one who is literate to receive an engineer's diploma after going through a course of study lasting four months.

All of the foregoing is an accurate and truthful account of present day conditions in the Empire that was formerly so fabulously rich. Of the former glamour and beauty, nothing, literally nothing, has been able to survive, and it is impossible to avoid feeling a deep sense of pity for this people who from top to bottom are naturally so well endowed with intelligence, but who have now been sacrificed upon the altar of experiment by a few mad-caps seeking Utopia on earth.

HAMMER DRILL CLEARS MINE PUMP COLUMN

IN A PAPER recently contributed to the *South African Institution of Engineers*, G. T. Andrews gives an interesting account of the various expedients employed in endeavors to clear the scale from the delivery piping of mine pumps and of the ultimate successful use of a hammer drill for the purpose.

At one time all the drainage from the mine in question was successfully handled through a column of 8-in. piping lined with wood of such a thickness that the internal diameter was 6¾-in. At a later date, however, it became necessary to increase the pumping capacity by the addition of duplicate pumps. When the new pumps were started it was found that the pipes had been so choked with a scaly deposit, probably on account of faulty treatment of the water prior to pumping, that the anticipated discharge was not realized. At the ninth level, for instance, there were two 6¼-in. by 9-in. Pearn pumps running at 47 to 50 revolutions per minute, and delivery through 1,000 ft. of piping, representing 763 ft. of static head. With one pump running the pressure was 390 lbs. per square inch, as against 342 lb. when standing, while the motor required 50 ampères; but with both pumps working the pressure went up to 510 lb. for a combined consumption of 125 ampères. Much the same conditions prevailed at the other levels, and as the capacity of the pipes was obviously only equivalent to that of a 4-in. pipe, it was decided that the delivery column should be cleaned out.

The first proposal was to purchase six new 18-ft. lengths of pipe, and by putting them in place of the choked pipe, permit the column to be cleaned piecemeal. The cost of this scheme was estimated at £585,* and the duration of the job 26 shifts. Mr. Andrews then tried to clean a length of the piping by pulling through it a piece of 6-in. piping machined to a sharp edge. The experiment resulted in smashing a 3-ton chain tackle, while substituting a prong cutter for the 6-in. pipe only left grooves where the cutters had passed. A jackhammer was then tried for driving a cutter through the pipe, and compressed air used to clear away the sediment, but it soon jammed. The next attempt was with a Hydromax machine, with water to clear away the chips, and it went through the pipe in a few minutes. Some further experiments were made on these lines, but it was found that the sediment got behind the cutter and clogged up the machine.

Finally it was decided to fix the cutter at one end of a length of 1¼-in. pipe and the hammer at the other. It was found that a satisfactory blow could be delivered to the tool with 150-ft. of pipe intervening. This result led the way to the arrangement of a rig with which the column was cleaned *in situ*.

The cutter was a cup-shaped tool 6⅝-in. in diameter, with four concentric cutting edges and a 5-16 in. central hole for the washing water. It was screwed on to one end of a length of 1¼-in. water pipe and a 2 1-16 in. Hydromax hammer-drill on to the other. The hammer was fitted up with crossheads and a sliding frame of 1¼-in. pipe arranged to guide it. Two joints in the water column were broken at any convenient place, and the intervening section of pipe swung out of the way, but left in place sufficiently to carry the weight of the pipe above. The hammer and its frame were then set up in the opening between the pipes, and the cutter driven down the column, additional lengths of 1¼-in. pipe being added as required. The longest continuous length thus cleaned was 378 ft. lying at an angle of 38°, but it was found that beyond 200 ft. the weight of the pipe was so great that the progress of the tool had to be checked by a rope.

The average cleaning speed of the whole job worked out at about one foot per minute and the cost at £160,* including all material and experiments. The effect was a reduction in the pressure, with both pumps running, of 150 lb. per square inch, equivalent to a saving of over 1s. 2d. per hour.

The Singer Building in New York is to use oil instead of coal for its five steam boilers with an estimated consumption of about 100 barrels per day.

*This figure does not take into account prevailing rates of exchange.

WHY DIRECT SELLING?

*By WILLIAM L. SAUNDERS**

President American Manufacturers Export Association

JUST AS a straight line is the shortest distance between two points, so is direct selling the shortest and surest way to sell goods. This axiom applies as well to domestic as to foreign trade. Manufacturers at home have the means to reach customers by direct methods,—they know the country, the ways of doing business and the facilities for financing orders, hence domestic trade attracts first attention and returns come in in large volume. Not so with foreign trade. With the exception of a few of the larger manufacturers there has been little determined and fruitful effort to reach foreign fields. Every one has at all times been willing to give special discounts to agents for foreign trade, to send catalogues, to advertise, and even to share the expense with others in sending a traveling man abroad; but this only approaches the situation; it is a mere picking process which sometimes enables one to get rid of a surplus stock at a sacrifice, but it does not, and cannot, establish those relations which are a necessary precedent to a permanent and enlarging business. Such methods are amateurish and not professional. We all practice them in the beginning. When we get wise through experience, we turn to direct selling.

In the early days the Ingersoll-Rand Company was represented by agents at home and abroad. In domestic work many of those agents were of long standing, they were looked upon almost as a part of the company. The business had been profitable for all concerned. But it became apparent that in territories where direct selling was resorted to, both through traveling salesmen and by establishing branch offices, the proportion of business obtained was much greater than even with the best agents. This resulted in the adoption of a branch office policy in all new fields and the gradual replacement of agencies. In some cases we located a man and sometimes an office force under the same roof with the agent, coöperating with him by giving a more direct contact to the agent. This policy usually brought larger sales and more profit to both principal and agent. In some cases the agent was taken over, placed on the pay-roll and brought at frequent intervals to the home office and the works for education and closer contact. In time he became a branch manager. In other cases the branch gradually absorbed or replaced the agent entirely. In others they both did and have continued to do business in the same office side by side, to the satisfaction and profit of both.

If this process is good business at home, how much more necessary it is to follow it in developing foreign fields. It seems to me to be altogether a question whether or not we are in a position to finance a project looking to the extension of one's business on a permanent scale. All experience points to the conclusion that if we have a product of value, something which is, or which might be, used in a foreign locality, and if there is a fair chance to sell it at a price not too much above that of the native product, we should send one of our best men to first look over the ground and then open an office there. At first, except with large concerns with plenty of money, it is best to get desk room in a house of established reputation. This enables one to get accustomed to the ropes, to learn the ways and means of doing business and to obtain credit. After a while, if all goes well, the branch can be extended.

It is obviously best to send men abroad who speak the language of the country where they do business; but this is not always an essential condition. To know the product and the business is the first and most important qualification; to have business judgment, tact and adaptability to meet conditions as they arise is next in importance. The right man will make connections with those who speak the language, he will keep things going until he himself learns the language.

In no case that I am familiar with has a business been established on any large and permanent scale abroad except through direct selling. I have a case in mind where a foreigner had the agency of an American product. He was doing a good business and the manufacturer at home was well satisfied. This agent retired from business. An American youth, who was only a sales clerk in his office, was made manager, and he doubled the business the first year.

All foreign connections are not the same in their methods of doing business, hence there is no rule of three that can be set down as applicable to all of them. In some it pays to talk American goods, for there is a charm about the name; in others to say that the goods were made in America is of no selling value. A good man on the ground will learn how to steer these things.

Not only does direct selling bring the maker and buyer in closer contact and afford means of mutual sympathy and interest, but it enables the maker of the goods to more nearly meet competitive conditions. It shows him how to build his product to meet the needs or the fancies of his customer. He gets closer to him. There is also a psychological value in direct selling. The customer thinks and feels that he is in a position to get better prices and terms. Close contact between principal and agent always makes for the best results; there is created a mutual bond of interest. All trade to be permanent and profitable must contain the elements of mutuality of interests. Direct selling promotes this; it is like seeing a man yourself and talking things over with him rather than writing letters or sending some one else to talk to him and represent your case.

Direct selling through advertising alone cannot fully meet the situation. It does some good in certain lines which are simple or of a common or standard nature; but it is at best unsatisfactory and of temporary value. All buyers in all countries like to place orders with some one who is on the spot. In machinery trades this is of the greatest value. The buyer feels that there is some one nearby to take care of the product, to see that it performs properly and to aid in overcoming difficulties and in repairing trouble.

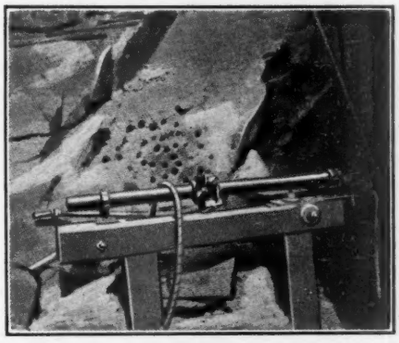
The English people are the greatest traders in the world. They have pursued the policy of direct contact with peoples of other nations. They are constant travelers, going to the fields which they seek to cultivate, studying the conditions, getting acquainted and establishing connections that lubricate the machinery of business and make it easy for people to trade with them. We shall do well if we follow methods which have led to success. To some this policy looks expensive. It costs money to get it established, but if our product is good and our shops big enough, we shall find that it is the best investment in the end.

*In an address at Seventh National Foreign Trade Convention.

TESTING ROCK DRILLS

After rock drills have been repaired, some kind of test is necessary before they are sent to the working place. In the absence of a special testing machine, according to *Engineering and Mining Journal* various expedients are resorted to in the shop. These range from the simple method of turning air into the machine and operating it, to the one illustrated in the accompanying illustration.

In many cases suitable rock for drilling cannot be obtained as close to the repair shop as may be desired, but under such conditions a block of granite can be provided or any other rock of firm texture and sufficient hardness. The picture shown was taken at the Mountain King mine, at Mountain King, Cal. Alongside of the shop where drills were sharpened and repaired a drill stand was erected so as to permit of the drills being tested against the "greenstone," which is a common rock in the neighborhood and which is both hard and tough. The drill is set up and tested by drilling a hole sufficiently deep to prove that it is in good condition.



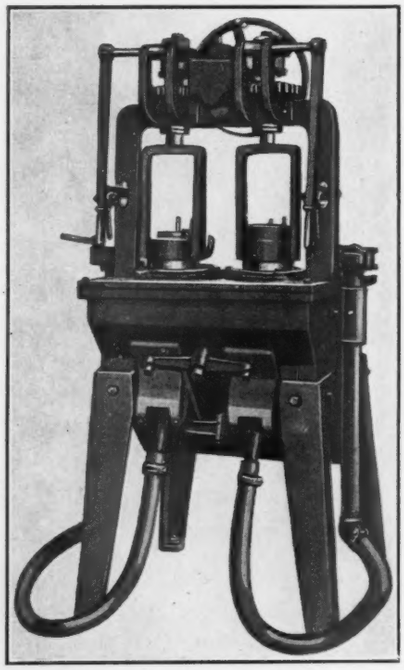
Mechanism used to test rock drills

The Anaconda Copper Mining Co. of Great Falls, Mont., recently sent another carload of pure zinc from its plant to the American Brass Co. at Ansonia, Conn., amounting to 1,250,000. This made the second shipment within 35 days.

The steamship *Italia* built by the Submarine Boat Corporation, recently successfully completed its trial trip after which it was expected to sail for Havana with a cargo of steel.

SAND BLASTING MACHINE CLEANS AUTO ENGINES

A COUPLE of years ago, when manufacturing activities were so largely devoted to the production of munitions of war, COMPRESSED AIR MAGAZINE illustrated and described sand-blasting machines for cleaning the interiors of cast steel shells. Pistons of automobile engines require to be similarly cleaned on the inside and while such pistons are not used in such numbers as were the war shells they are still numerous.



Gray Piston Blasting Machine.

The machine, made by the Gray Machine Tool Company, Inc., Buffalo, N. Y., uses a blast carrying steel grit or shot, and is said to be capable of cleaning pistons at the rate of 140 to 150 per hour. There are two rotary carriers in which the piston is placed, open end downward, and covered with a cap. These carriers are rotated alternately under the control of the operator so that while one piston is being cleaned the other may be changed. The blast nozzles are adjustable to any desired position and usually operate at the mouth of the piston opening. A lever operated quick-opening valve in the air line controls the blast. Pistons are handled up to 3½ in. diameter. The air consumption is about 40 cu. ft. free air per min. at 70 to 90 lb. pressure.

PAINT SPRAYING FREIGHT CARS FROM DISTANCE

*By NORMAN McCLEOD**

CONSIDERABLE OBJECTION has arisen against a number of paint spraying machines used in painting freight cars, the workmen complaining of inhaling the spray when operating these appliances due to the operator having to stand too close to the outlet of the sprayer. In order to eliminate this serious feature, which imperils the health of the men, a machine has been so designed that the operator stands a considerable distance from the object being painted. This device also has the advantage of allowing the painter to have quite a lengthy pipe in his hand, the nozzle or sprayer being on the farther end and a considerable distance from his face, while with the ordinary spraying machine the spraying pipe or nozzle is practically no farther removed than the length of the operator's arm.

The machine consists of a cylindrical 3/16-in. steel tank 11½ in. by 26½ in. inside dimensions, mounted on a wheel-barrow framework which facilitates handling. The filling of the tank with paint is done with a funnel through a large filling hole located on top of the head. Cleaning, inspection or repairing are facilitated by the removable top head held in place by four hook bolts and made air tight with a leather gasket.

After filling the tank with the required amount of paint, air pressure (80 to 90 pounds per square inch), is introduced in two places, first through a one-inch check valve and a perforated one-inch pipe at the bottom of the tank and an auxiliary three-fourth-inch connection leading off from the one-inch by one-inch by three-fourth-inch tee between the main supply globe and check valves to a tee on a one-half-inch vertical pipe in the top head. At this tee the air is diverted, allowing pressure to go in the top of the tank and to the atomizer, where it is joined by the paint, brought to the atomizer through a three-eighth-inch pipe the end of which reaches within one-half-inch of the bottom of the tank.

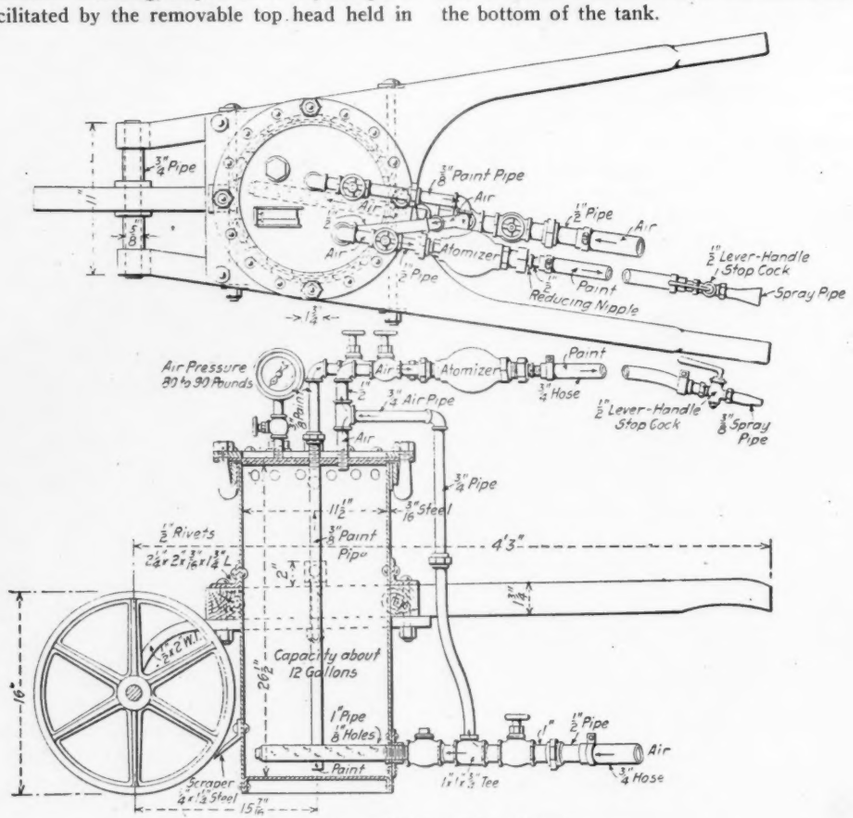


Fig. 1.—Portable Paint Sprayer.

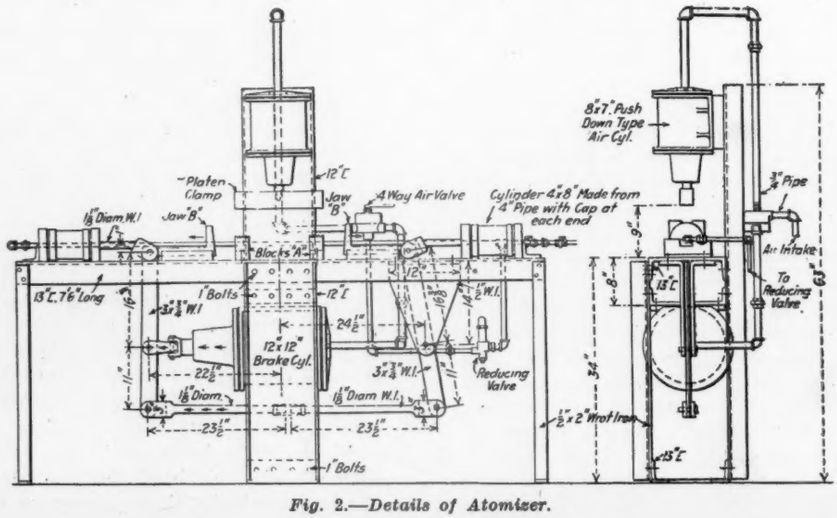


Fig. 2.—Details of Atomizer.

*In Railway Maintenance Engineer.

San Joaquin Light and Power Corporation's Kerckhoff Power Project

Compressed Air Equipment at the Hydro-Electric Power Development to Utilize the Water of the San Joaquin River at Auberry, California

By W. C. COLLYER

THE HYDRO-ELECTRIC development at Auberry, California, now under course of construction by the San Joaquin Light and Power Corporation, has for its object the utilization of the waters of the San Joaquin River for generation of electric power. The development involves the construction of a dam, three and one-quarter miles of water tunnel, a penstock and power house.

With the main supply depot at Auberry,—the nearest railroad point—the tunnel construction was started at four different points along or near the tunnel right of way, so as to carry on the work of driving the tunnel at five different headings. Camps were built at each of these points to house the working personnel. These camps are located on two construction roads leading from Auberry, one to Camp No. 2 at the north portal of the tunnel about three miles from Auberry, and the other to Camps No. 4 at the south portal, No. 3 at Adit No. 2 and No. 3A at Adit No. 1, respectively, four, four and one-half, and five miles from Auberry. As all the construction material had to be hauled over these roads by motor trucks or tractors, the roads had to be exceptionally well constructed to stand up under the heavy traffic. The road construction required a good deal of rock excavation which was done with the aid of Ingersoll-Rand jackhamers and portable compressors.

The water tunnel which, as stated, is to be approximately three and one-quarter miles in length when completed, is being driven from five different headings as follows: one at the north portal working south; one at Adit No. 1 working north to meet that proceeding from the north portal; two at Adit No. 2, one working north to cut in at Adit No. 1, and one working south to meet the heading which is working north from south portal. Contracts have been let for all tunnel work: W. M. Whitmire contracting both headings at Adit No. 2, and D. D. DeLucca contracting the headings at north and south portals and Adit No. 1.

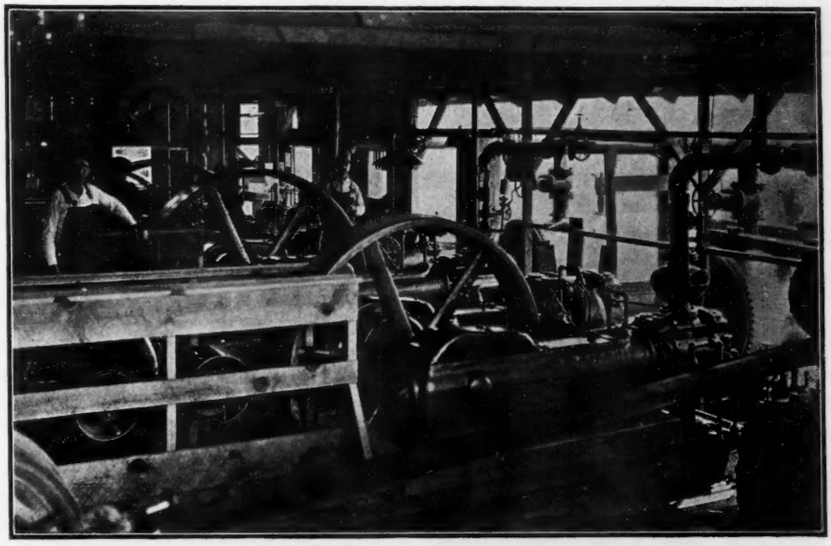
The tunnel section is 17x17 feet. The work is conducted by carrying a heading and an eight-foot bench. The drill holes are generally fifteen feet deep, although the cut holes in the headings and the lifters in the bench are frequently drilled to seventeen feet. At the Adit No. 1 heading, where the ground has recently been breaking well, cuts as high as nineteen feet, and lifters of 22 feet have been used. Using fifteen-foot holes, the rounds generally break from eleven to thirteen feet, while the deeper holes break a fifteen-foot or even a sixteen-foot round. It requires from 50 to 60 holes in the heading and ten to fifteen holes in the bench properly to break a round. The ground is hard close-grained granite.

The general practice on this job is to use six drills in the heading and four on the bench, the drills in the heading being mounted on arms, three to a column, and those on the bench mounted on a cross bar. The drilling equipment consists of 52, No. 248 Leyner-Ingersoll drills, and 23, No. 61 Waugh turbo drills, all using 1¼-inch steel and working on 100 pounds air pressure. The Leyners are doing the work on four headings and the turbos on one heading.

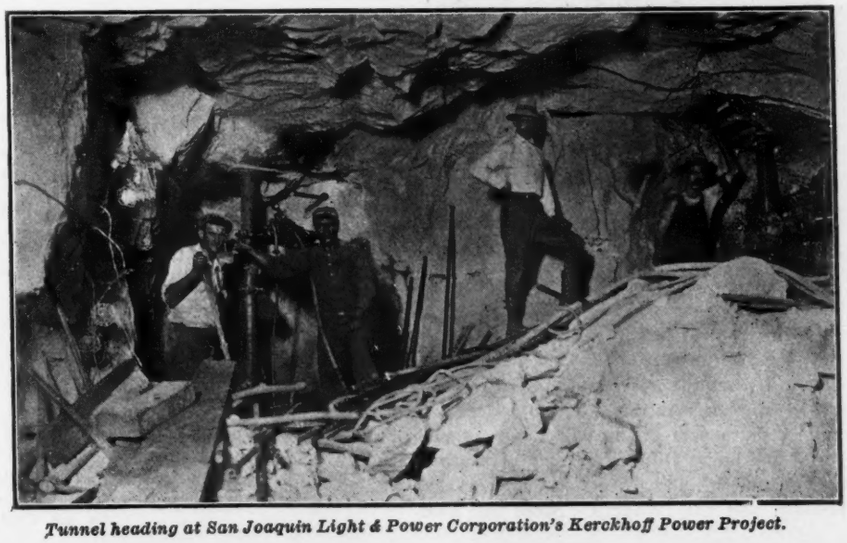
Mucking is done by steam shovel equipped with twenty cubic foot buckets, using air for power. It has been found that it is essential to have 100 pounds air pressure at the shovel to obtain the best results. It usually takes the shovel from six to twelve hours to clean up the muck pile.

The work is conducted at the several headings so as to save all the time possible, as speed is essential in the tunnel construction. As soon as the round has been broken and the tunnel ventilated, the shovel is moved up to the muck pile, and the men start mucking back from the heading by hand so as to clear the bench for the new drill set up as soon as possible. Two drill columns are set up in the heading, each mounting three drills on arms. As soon as the muck is cleaned up the shovel is moved back, the bench drilled and the round is shot. From 700 to 900 pounds of explosive are required for each round, using 60 per cent. gelatin dynamite.

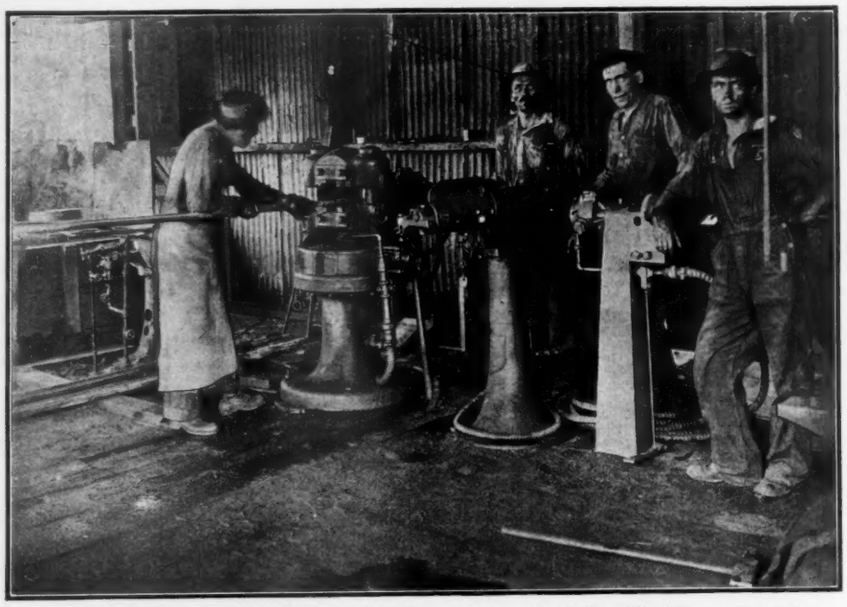
The best record obtained in driving this tunnel was made during the month of March, 1920, at the heading at Adit No. 1. This heading was driven 439 feet in that month, an average of slightly more than fourteen feet a day of three eight-hour shifts. The average footage of all headings in the month of March was probably 340 feet.



Battery of Imperial XB Compressors on San Joaquin Light & Power Corporation's Kerckhoff Power Project.



Tunnel heading at San Joaquin Light & Power Corporation's Kerckhoff Power Project.



Blacksmith shop—San Joaquin Light & Power Corporation's Kerckhoff Power Project.

Air is supplied for all headings by 22 Ingersoll-Rand compressors in the following sizes and types:

Four 9 in. x 8 in., ER-1.
Six 12 in. x 10 in., ER-1.
One 14 in. x 9 in. x 12 in., XB-2.
Six 15 in. x 9 in. x 12 in., XB-2.
Five 17 in. x 10 in. x 14 in., XB-2.

Jackhamer used on San Joaquin Light & Power Corporation's contruction job.

These compressors have sufficient capacity to keep air supplied to the steam shovels, drills and steel sharpeners. Four-inch air lines are installed from the receivers to the headings and pressure is maintained at 100 pounds.

Steel sharpeners are installed, two at each portal and adit. Different makes of sharpeners are used, including five No. 5 Leyners, one Sullivan and two Waughs. Since the number of pieces of steel to be sharpened for each heading per day, amounts to from 500 to 600, it is essential that at least one dependable sharpener be installed for each heading.

The work is under the direction of Mr. R. C. Starr, construction engineer, and his assistant, Mr. H. R. Stevens, superintendent.

A NOVELTY IN BRICKS

A new brick that has recently been introduced in England is nearly five times as large as an ordinary brick, but in comparison is much less heavy and is easily handled. The lighter weight results from the hollowing out of the brick to provide air layers. By the shaping of the ends the existence of joints running all the way through a wall is avoided. The brick is, as a rule, made of one part of cement and four parts sand by simple hand machinery. Three men can make enough bricks in a day to build 400 to 500 square feet of wall. A further economy is effected by the manner of laying the walls, inasmuch as the ends and bottoms of the bricks need only to be dipped in a thin lime mortar mixed with a small amount of cement. If laid in the usual way the air channels in the bricks would become filled. It is said that slag, clinkers, sand, and brick dust, mixed with cement, form suitable materials for these bricks.

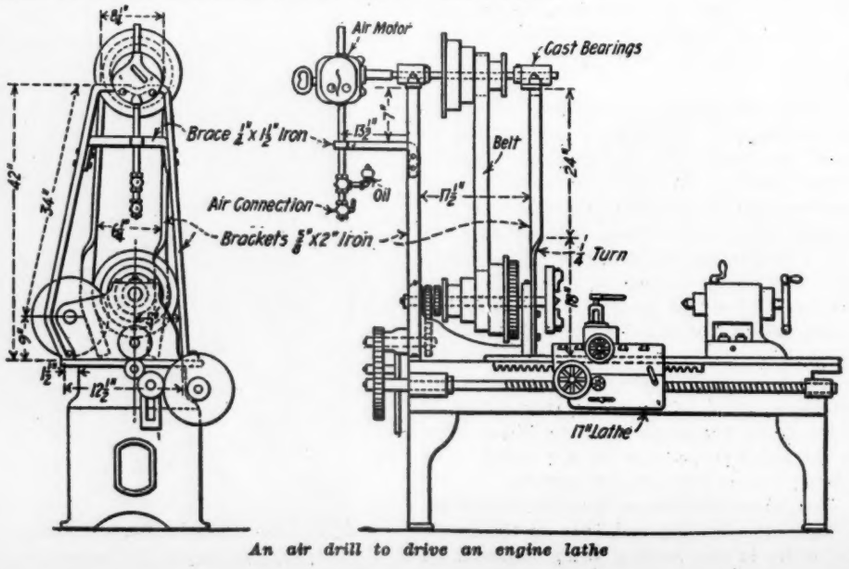
AERIAL SPEED RECORD

In a recent flight from Rome to Turin a new speed record was made by Lieut. Brack-Papa in an A. R. F. biplane constructed by the Fiat Company and equipped with a 750-horsepower twelve-cylinder Fiat engine. The machine started from the Mirafiori aerodrome, in the suburbs of Turin, at 11.45 a. m. on April 5th, carrying two passengers in addition to the pilot, and landed on the Centocelle ground, just outside Rome, at exactly 2 p. m. The intervening distance of 388 miles was thus covered in two hours fifteen minutes, the average speed being just over 172 m.p.h. A few days previously the same machine was officially timed over the Mirafiori aerodrome, and found to give an average speed of 161.5 m.p.h. with four passengers and a pilot. In this flight the effects of wind were, of course, eliminated, and the speed attained, we understand, constitutes a world's record.

AN AIR DRILL TO DRIVE AN ENGINE LATHE

The cut here reproduced from *Railway Review* tells its story clearly and completely. At an inconspicuous location on an eastern railroad, where it was convenient at odd times to do minor repairs upon locomotives temporarily waiting there, it happened that no motive power was available for any purpose while it was very desirable to run a small engine lathe occasionally; and how it was done is seen in cut.

The rig is entirely self contained and the lathe may be placed anywhere without careful leveling or lining up. A light iron or steel framework was put together and fastened to the headstick of the lathe, and upon this was mounted the lathe countershaft and a pneumatic rotating drill to drive it. The air to drive the drill was readily obtainable by connecting with the air reservoir of the engine under repair.



An air drill to drive an engine lathe

St. Paul's New Union Depot Serving Ten Railroads

Compressed Air Used in Building Structure and Utilized for Testing Air Brakes, for Repair Tools and for Engine House Requirements

By Francis Judson Tietsort

ST. PAUL, of Twin City fame in the Northwest, is beginning to derive the benefits of its new Union Depot, the headhouse of which is now occupied and serving passengers. The old St. Paul Union Depot was burned in the Autumn of 1913, and in the last seven years temporary terminal facilities have been maintained in a building adjacent to the old depot property which was formerly occupied by a wholesale mercantile house.

Our photographs show the new depot project and views of it in course of construction. The new terminal, when completed in all its details will be a "Gateway to St. Paul" worthy of that thriving and alert community. It will serve the Great Northern, the Northern Pacific, the Chicago, Milwaukee & St. Paul, the Chicago, St. Paul, Minneapolis & Omaha (with the Chicago & Northwestern), the Chicago, Rock Island & Pacific, the Chicago, Burlington & Quincy, the Chicago Great Western, the Minneapolis, St. Paul & Sault Ste. Marie and the Minneapolis & St. Louis railroads.

Studies on plans for rebuilding the headhouse and enlarging the station yard were begun immediately upon the destruction of the old building. These studies developed a plan which was approved by the St. Paul City Council and adopted by the depot company in 1914. It provided for enlarging the station yard by shifting the harbor lines of the Mississippi River to the southward and creating additional areas of land on the north bank by filling. The plan, however, met with opposition from the War Department; and the objections were so far-reaching that the depot company concluded to withdraw the proposition.

After the withdrawal of the first plan, another plan was developed which provided for expanding toward the city instead of toward the river. This plan was adopted in 1916 and the company proceeded to acquire the necessary property.

A contract was let in July, 1917, to Morris, Shepard & Dougherty and the George J. Grant Construction Company for the entire work. Work was begun in August of the same year and continued until January 1, 1918, when the railroads were taken over by the Government, and work was practically suspended until August, 1918, waiting the approval of the Railroad Administration. It has been prosecuted continuously since that date.

The plan adopted provided for the headhouse to be placed north of Third on the block bounded by Third, Sibley, Fourth and Wacouta streets. The building extends over Third street, with eighteen feet clearance, connecting with the waiting room, which extends across the station yard, with seventeen feet head-room over top of rail of station tracks. Elevators and stairways connect the waiting room with the passenger platforms.

There are four floors in the headhouse, viz: basement, Third street level, main floor and office floor. The basement contains the mechanical equipment, work rooms, and immigrants' rooms. The Third street level contains the restaurant, office and supply rooms, janitors' quarters, storage rooms and surplus space for rental purposes. The main floor contains the business lobby, kitchen, lunch and dining rooms, women's waiting room, ticket office, store, barber shop, toilets and parcel check room. The smoking room and baggage check room are on this floor over Third street. The office floor contains the depot company's offices, women's retiring and emergency rooms, and the terminal railway post office.

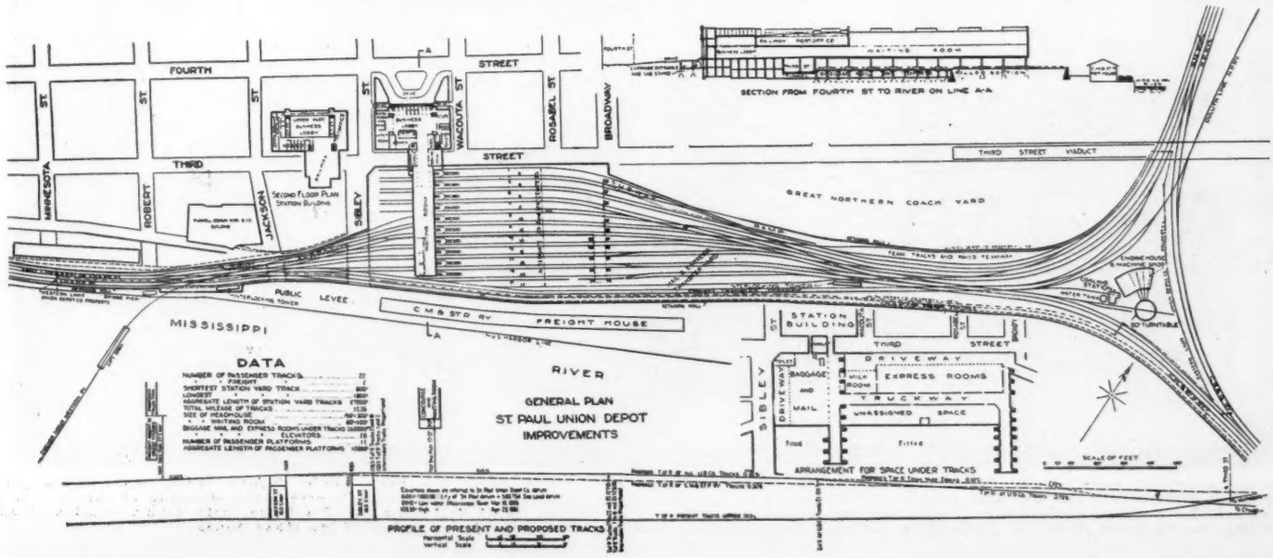
The headhouse is of reinforced concrete frame with Bedford stone facing. The main floor and Third street level floor are of flat slab design. The office floor is of beam design with hollow tile and concrete joist floor slab. The waiting room is of steel skeleton construction with brick facing.

There are 22 passenger tracks in the station yard, and two freight transfer tracks along the southerly edge of the depot property. The passenger tracks are in pairs 12.5 feet and 29.5 feet center to center respectively. The platforms are 19.5 feet wide. There is a grade transversely across the station yard, descending from Third street southerly at the rate of three inches in 42 feet. The tracks on either side of the platforms are the same elevation, the drop of three inches being made between the two tracks 12.5 feet apart.

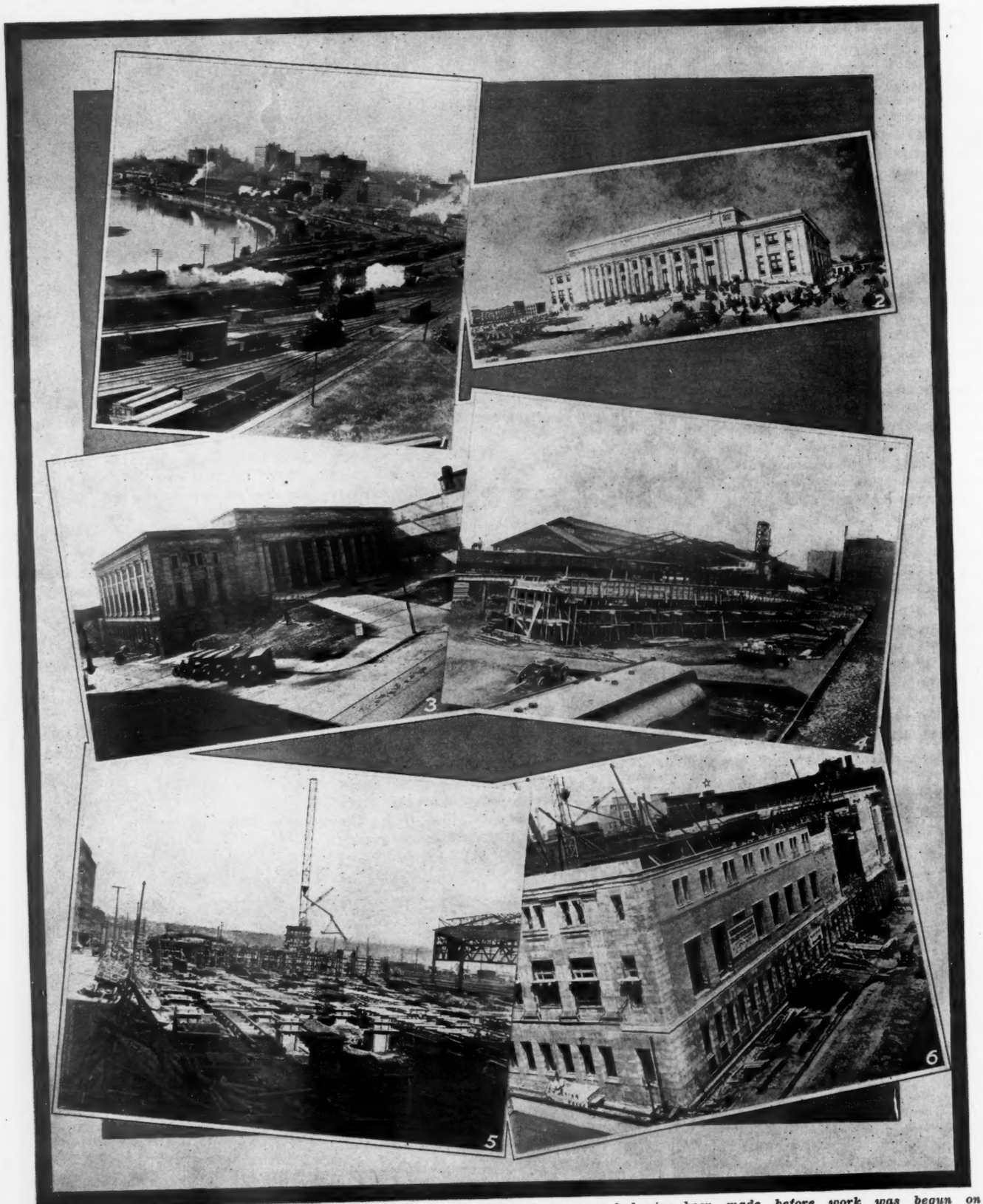
About 260,000 square feet of the station yard immediately south of Third street and extending from Sibley street to Broadway is on structure, with rooms for baggage, mail and express underneath. The train sheds are of the "butterfly" type.

The construction organization includes: W. C. Armstrong, A. S. C. E., Chief Engineer; G. H. Wilsey, Structural Engineer in charge of design; O. L. Hoebel, Assistant Engineer in charge of construction; W. B. May, Assistant Engineer; A. A. Sommerfeld and F. E. Cave, structural designers; Chas. S. Frost, architect; Toltz Engineering Company, structural engineers for architect; W. R. Powrie, A. S. C. E., general superintendent for contractors.

Compressed air played an important part



A Gateway to the Northwest—the New Union Depot at St. Paul.



1.—An historical view of the Union Depot railroad yards, St. Paul, this photograph having been made before work was begun on the new terminal and yards. The business section of St. Paul is to be seen in the background. 2.—Architect's perspective drawing of the new St. Paul Union Depot. 3.—As completed section of new terminal looked this spring. 4.—Concrete forms and walls for trackings. Old Union Station Sheds in background. 5.—Concrete forms for trackage in the new Station Yards. 6.—View of the northeast corner of the Head house.

in the construction of the new terminal, the extensive steel work having been done with air riveters. The depot company is to make use of an air compressor for the testing of air brakes at the terminal. The engine house will also have an air compressor of 150 cubic foot capacity, with electric drive. This compressor will be used for operating air tools used on repairs and will be utilized for "blowing up" locomotives. Several of the railroads using the terminal are owners of compressed air tie-tamping outfits utilized in economical maintenance of rights of way.

FOR BETTER MAINTENANCE OF AIR COMPRESSORS

*By MARK PURCELL**

FROM A survey of the general situation on railroads in connection with train operation and when direct inquiry is made, the usual impression is that compressors are giving good service, although at the same time service records may show a large amount of wheel sliding and breaking in two of trains that, from first analysis, would not appear to have any relation to, or to any extent to be due to, the manner in which the compressors were operating, and yet careful, or even casual, investigation develops in many cases that the compressor is largely responsible for the trouble.

If a compressor runs slow, or for any reason raises the pressure slowly, there may not be enough accumulated after a brake application is made, for slowing down or stopping, to make a proper release, and the engineer, being necessarily anxious to avoid delay, attempts to release and proceeds with the result that only some of the brakes are released and wheels are slid or drawbars pulled out; and, with passenger trains, passengers are annoyed and sometimes injured by rough handling of the train, and still the compressor has not actually stopped and refused to work.

From such conditions as those outlined in the foregoing, and those cases coming up occasionally where the compressor fails completely, we investigate further as to cause and remedy, and find that most of the low efficiency and some of the failures are due to lack of repairs, or to the quality of the repairs made being below, though often only slightly, the standard required. In some cases it is an error in a single particular, but more often in a combination, such as a number of leaks, any one of which may be too slight to cause trouble, yet when combined becoming serious. The above applies more particularly to compressors having steam and air cylinders compounded, on account of the balancing effect that may be caused by leakage.

It is not uncommon to find a compound compressor that is chronically inefficient, and be advised that one part after another has been repaired or replaced, until all or nearly all of the working parts have been gone over, and yet the operation is not improved. Some such cases are a matter of record, where a careful inspection showed everything in fair condition, except the high pressure air piston rings were 3/16 to 5/16-inch open, or rings in both high and low pressure air pistons 3/16 to ¼-inch open when in the smallest part of cylinder, of rings in some of the pistons of the main valve 1/8 to 3/16-inch open and a poor fit in the grooves, and when these are properly repaired the compressors work all right.

In one case an 8½-inch cross compound compressor developed pounding, would not supply sufficient air, and the engine had to be taken off an important train. Examination showed that the rings in both the high and low pressure air pistons were 3/16 to 5/16-inch open at the ends and lacked about .012-inch of filling the ring grooves. New rings that would fit the cylinders, but were .012-inch smaller than the grooves, were applied to both the air pistons, and the compressors gave good service for four months, and probably longer, but records do not show.

Still another. An 8½-inch cross compound compressor pounded some, and ran so slow with 190 pounds steam pressure that it would not keep up 90 pounds standard brake pipe pressure on a regular passenger train of ten cars, against normal leakage. Examination showed:

(a) Main steam and air cylinders slightly worn. (b) Steam cylinder head parts in good condition. (c) Main steam and air pistons about 1/32-inch smaller in diameter than their cylinders. (d) Packing rings in steam and air cylinders came together at ends in smallest part of cylinders and were a little less than 3/32-inch open in largest part of cylinders. (e) Rings lacked .005 to .008-inch of filling grooves in high pressure steam cylinder. (f) Rings in low pressure steam cylinder lacked .012 to .015-inch of filling grooves. (g) Rings in high pressure air cylinder lacked .015 to .018-inch of filling grooves. (h) Rings in low pressure air cylinder lacked .012 to .015-inch of filling grooves. (i) Upper final discharge valve had a 3/16-inch lift, one upper intermediate valve had 7/32-inch lift and other air valves had only slightly more than standard lift.

New pistons that would fit the cylinders closely at the smallest part, and in which the rings fitted the grooves with just enough clearance so they would expand by their own tension when compressed into the grooves, were applied and no other repairs made, and the compressor given a severe running test in which its capacity and speed developed were fully up to standard.

Recommended standards to cover repairing and adjustment of the different parts of compressors have been extensively published and discussed ever since the cross compound compressor came into use, but general observation would indicate that these are not taken seriously and appear to be seldom considered in connection with compressor repairs and maintenance. On account of this, the general standard of service of these compressors is considerably below what may reasonably be expected, and what may be obtained by uniformly raising the standard of quality of work done in maintaining them, which may be done at slightly increased cost, and by simply following standards such as those outlined in recommended practice by the Air Brake Association.

The Northwest Air Brake Club believes that it is time for a general awakening to the need of progress and improvement along these lines, and that the logical and most effective means of bringing about such improvement is through the influence of the Air Brake Association and the air brake clubs throughout the country. The number of engine failures chargeable to the air compressor alone, indicate the need for improved compressor maintenance, and the other troubles that can readily be traced directly to a lowered compressor efficiency, emphasize it to a high degree.

*General air brake inspector, Northern Pacific Railroad. Paper read at the annual meeting of the Air Brake Association, Chicago.

SAND-HOG TEREDOS

The ability of teredos to work and thrive under considerable pressure has had practical demonstration. Two wood-stove pipe lines through which the Union Oil Co. pumps salt water at Oleum, Cal., have been entirely destroyed by teredos which must have been drawn in through the centrifugal pumps and entered the wood staves from the inside. The pipe-lines were 10 and 12 in. diameter, respectively, and were operated under a pressure of 40 lb. per square inch. The pipes were damaged so badly that they had to be replaced. When detailed examination was made it was found that the teredos were in a thriving condition, some of them having attained a length of eight inches.

MERGER OF ENGINEERING CORPORATIONS

Of general interest is the combination recently announced of the organizations of Westinghouse, Church, Kerr & Co., Inc., engineers and constructors, New York, and Dwight P. Robinson & Co., Inc., constructing and consulting engineers, of New York.

The new company will be called Dwight P. Robinson & Co., Inc., and will occupy executive offices at No. 61, Broadway, and engineering and designing offices in the Grand Central Palace, No. 125 East 46th Street, New York.

Mr. Dwight P. Robinson—president of the new company—was for many years president of the Stone & Webster Engineering Corporation, and formed his own company in 1918. At the time of the merger the Robinson Company had large power plants under construction for the Duquesne Light Co. at Pittsburgh, the Penn Public Service Co. at Johnstown, Pa., and others.

Westinghouse, Church, Kerr & Co., Inc.—established 36 years ago—has specialized in the design and construction of industrial plants of all kinds, railroad shops and terminals, and industrial power plants.

Jerome Alexander, in a paper read before the American Chemical Society at St. Louis, recently announced the discovery of a new fuel fluid, greater in heat value than either coal or present fuel oils. He asserted that the fluid would prove valuable to navigation, permitting a wider cruising radius, and could be used for smoke screens. The new fuel utilizes coal waste and cheap tars.

CONVENTION OF RAILWAY SUPPLY MANUFACTURERS

THE CONVENTION of the Railway Supply Manufacturers' Association held at Atlantic City, June 9-16 was record breaking in all its aspects. The attendance, which has been estimated at over 9,000 persons, by some veteran railroad men, was a striking indication of the enthusiasm which permeated this meeting of the men engaged in the railway supply business.

The association was confronted with a big problem this year, and that was to try to take care of as many prospective exhibitors as possible. Every inch of space on the "Million-Dollar Pier was utilized, even including the balcony of the main hall. The exhibits occupied more than 100,000 square feet and when this was exhausted, many applications of large and prominent companies had to be turned away, and many others were asked to be satisfied with less space than they desired.

On the committee in charge of the exhibits were J. G. Platt, Chairman; C. W. Beaver, E. H. Bankard, Jr., J. M. Gillespie, and H. G. Thompson.

Among the exhibitors were the following:

Baird Pneumatic Tool Company, Kansas City, Mo.Yoke type riveters; staybolt cutter; pinch bug riveter; pipe bender; furnace and working model of flue rattler.

Cleveland Pneumatic Tool Company, The, Cleveland, Ohio—Cleveland pocket-in-head riveting hammers in several sizes; 27 types and styles of air drills, comprising corner drills, compound drills, rotary drills, center spindle machines, stay bolt machines for plain and flexible bolts; chipping hammers, sand rammers, valve grinders, emery grinders in several sizes; Bowes air hose couplings; Cleveland neverslip hose clamps; Cleo pressure seated air valves and Cleco air hose fittings; riveter holder-ons; stay bolt hammers; mudring riveters; flue beading hammers.

Dayton Pneumatic Tool Company, The, Dayton, Ohio—Complete new line of pneumatic riveting, chipping hammers and sand hammers.

Duntley Pneumatic Tool Company, Chicago, Ill.—Duntley riveting, scaling and chipping and calking hammers; rivet cutters; electric drills; air drills; rivet sets; all accessories for pneumatic tools. The new Duntley sleeve valve for riveting hammers.

Electric Railway Journal, New York, N. Y. —Electrical Railway Journal; McGraw electrical directories; Electrical World; American Machinist, Power, Engineering and Mining Journal; Electrical Merchandising; Coal Age; Journal of Electricity; Chemical and Metallurgical Engineering; Engineering News-Record, Ingenieria Internacional.

Independent Pneumatic Tool Company, Chicago, Ill.—Thor pneumatic drills, reamers, grinders, hammers, hoists, rammers and electric drills and grinders.

Ingersoll-Rand Company, New York, N. Y.—Little David pneumatic tools and appliances.

New York Air Brake Company, The, New York, N. Y.—Reception Booth.

Railway Review, Chicago, Ill.—Copies of publication.

Simmons-Boardman Publishing Company, New York, N. Y.—Various papers and books devoted to shipping by land and water. The Railway Age, the Railway Mechanical Engineer, the Railway Signal Engineer, the Railway Maintenance Engineer, the Railway Electrical Engineer, Car Builders Dictionary, Locomotive Dictionary, Shipbuilding Cyclopedia, Marine Engineering and the Boiler Maker.

United States Rubber Company, New York, N. Y.—Rubber hose, packings, pump valves, axle dynamo belts, hard rubber products, friction tape and splicing compound.

Westinghouse Air Brake Company, Pittsburgh, Pa.—Universal passenger equipment demonstration rack of three cars and locomotive. Illuminated electric chart showing performance of UC passenger equipment with and without the electro pneumatic rack. Empty and load brake equipment demonstration rack. Westinghouse NA-1 friction draft gear complete; also a used gear taken out of service for test purposes after 25,000 miles' service on a large locomotive tender.

The committees in charge of entertainment and those that attended to the comfort and convenience of delegates and guests were more than successful in their endeavors and consequently this convention, which smashed all previous records for attendance, was conducted with entire smoothness.

The Railway Supply Manufacturers' Association has been rapidly expanding its organization in recent years and now has reached a point where its annual convention is national in scope both as regards geographical representation and numbers. In the last year, the affairs of the association have been under the direction of George R. Carr, the president, who is also the vice-president of the Dearborn Chemical Co., Chicago. Prior to becoming president, Mr. Carr was actively engaged in various committee work for the association. He was chairman of the entertainment committee in 1915, and in 1916 was elected a member of the executive committee. The increased number of the exhibits—the space increasing from 93,000 sq. ft. in 1919, to 100,000 in 1920—was largely the result of his efforts.

Mr. Carr is 43 years of age, was born in Argenta, Ill., and was graduated from the University of Illinois in 1901.

The track exhibit was a feature and received close attention from the visitors. On the Philadelphia & Reading track at Mississippi Avenue and the Boardwalk was the American Car & Foundry Co.'s tank car exhibit which included two cars, one of which was equipped with heater pipes. The latter car had one end removed so that the arrangement could be readily observed. The Lehigh Valley's hopper car of 110,000 lb. capacity was also stationed at Mississippi Avenue. In addition to these were the Clark Car Co.'s dump car of 100,000-lb. and 810 cu. ft. capacity and a working model of an automatic train pipe coupler manufactured by the International Couplers Co. The New York Central exhibited a Pacific type of locomotive with a trailer booster for increasing the starting tractive effort of the locomotive.

No adequate mention can be made of the numerous and varied kind of devices exhibited. They included all kinds of adaptations for pneumatic, steam and electric power, tractors, trailers, couplers, shop equipment and tools, lighting devices, in all a complete exhibit of railroad mechanical equipment.

IMPROVING COMPRESSED AIR ECONOMY*

COMPRESSED air is being used to an ever-increasing extent. While not a universal form of power, in the meaning that it is most efficient for all operations, it absolutely dominates in a certain field. This field is wide and possesses no definite demarkations, because compressed air is continually being employed for new applications and more intensively.

The great diversity of uses for compressed air has introduced a rather odd situation. The manufacturers of compressed air apparatus have evolved more efficient machinery, they have developed many refinements in design that make for longer life, more compact and lighter portable tools and similar improvements that increase over-all economy in the use of compressed air. But the success of compressed air, the economy of results, does not depend alone upon the manufacturer, but devolves equally, or perhaps to an even greater extent, upon the user.

Operators of industrial plants keep cost records for labor, fuel and materials. They meter the current consumption for light and power. They know what time and money are expended in treating any product in any shop. But how many are keeping tab on the compressed air used or how it is being produced, what is being done with it and whether the equipment for compressing, transmitting and utilizing it is maintained in top-notch condition?

Because the consumption of compressed air has attained such proportions, and every indication points to even more extensive use, it is becoming of the greatest importance that the pneumatic service be given more attention. A small loss here and there, each small individually, becomes appreciable and well worth saving in the aggregate. Further, these little losses in economy are usually quite easily eradicated. It is chiefly a matter of realizing that they exist, and then of stopping them.

Opportunity for economy exists before an installation is made, as well as after it is put into operation. The former requires that equipment be properly chosen and properly located; the latter that certain matters, such as ignorance, leakage, water, freezing and misuse, be prevented. The first take care of themselves once they are settled, whereas the latter require continual vigilance as with all phases of power production and usage regardless of the working media.

Compressing Plants

Whether the entire air production should take place at one centralized station or the major supply be produced at a centralized station and the balance at distributed stations depends upon the plant layout, air consumption of the different loads and the extent of the territory covered. A centralized compressor station augmented by one or more portable compressors sometimes proves the better solution where much ground is covered. Large individual consumers of air exist a long distance from the centralized plant and distant loads require higher air pressure than can be economically transmitted.

Ordinarily the centralized compressor station is the better solution, however, because it is more efficient, the investment is much less than that required for scattered stations and the cost of superintendence and maintenance is likewise lower. Moreover, greater reserve capacity for a given investment is usually obtained.

Co-ordinating Compressors and Load

Another matter concerning the initial installation which may react adversely or favorably by causing either continual expense or economy, as the case may be, is that of coordinating the capacity of the compressors in

*From the initial number of "Industrial Power," Chicago, May, 1920.

the central station to their load. Some loads vary but little, while others vary over a wide range. If the main compressors are of such size as to provide for the maximum demand but are of such capacity individually that one machine alone or more can be operated according to the periodic demand for air, economical operation at all loads, light as well as overload, obtains. The use of a sufficient number of compressors in the central plant, as well as of different capacities perhaps, is a factor influencing reserve capacity and reliability as well as over-all economy.

It is almost the invariable experience with centralized compressor installations that the initial capacity which suffices at first soon becomes too small because of the rapid increase in demands made upon it. This almost universal experience is due to a combination of different causes.

The chief reason why compressor capacity is quickly outgrown is because new uses for compressed air are found at a surprising rate, and each new use usually suggests another sooner or later. Another reason is that a compressor barely sufficient for immediate needs is often chosen by the management in the desire to keep the initial investment down, while the estimate of probable air consumption for different applications is often too low. Two lesser reasons are that leaks in air lines tend to increase with time, as does also the carelessness of the men in the use of air. Familiarity breeds contempt, and much air may be wasted through carelessness and abuse. These all make drains upon the compressing plant and reduce the capacity available for additional demand, while the demand actually increases.

Air Conditions

The condition of the air is a factor affecting efficiency, hence, economy, from the time the air is taken into the compressor until it passes out after being used at the point of consumption. This fact should be borne in mind not only at the time an installation is planned but so long as the installation is in existence. The aim should be to use cold, clean, dry air.

Air, like other gases, increases in volume as the temperature rises and decreases as the temperature falls. This fact influences the efficiency and capacity of the compressors as well as of the supply lines.

The air intake to the compressors should be so located and equipped that the incoming air will be clean and cold, hence, of minimum bulk. One location of the air inlet may not cost much more than another, but the influence of air inlet location exerts itself so long as the compressors are at work. The accompanying table shows the effect of initial temperature upon compressor efficiency and capacity.

Wet air is always objectionable. Moisture, slugs of water, interfere with the life of pneumatic tools, wearing away cylinders, cutting valves, washing out lubricants and interfering with lubrication. The tools do not function properly and their efficiency and endurance are lowered. The remedy is not difficult since it simply means using dry air, keeping it dry and paying attention to the installation and maintenance of after-coolers, traps, settling chambers, tanks and similar devices for entraining water and collecting scale and dirt.

Effect of Air Intake Temperature Upon Efficiency and Capacity

UNIT CAPACITY AND EFFICIENCY ASSUMED AT 60° F.

Initial Temperature Degrees Fahr.	Degrees Abs.	Relative Capacities and Efficiencies
—20	441	1.18
—10	451	1.155
0	461	1.13
10	471	1.104
20	481	1.083
30	491	1.061
32	493	1.058
40	501	1.040
50	511	1.020
60	521	1.000
70	531	.980
80	541	.961
90	551	.944
100	561	.928
110	571	.912
120	581	.896
130	591	.880
140	601	.866
150	611	.852
160	621	.838

Alcohol is used in enormous quantities in some plants to lessen freezing troubles, whereas after-coolers should be used. In these plants no effort is made to eliminate the cause of freezing and no attention is paid as to treatment or how often alcohol is needed to reduce the effect instead of eliminating the cause. The saving in cost of alcohol used indiscriminately and often uselessly would in most cases more than pay for after-coolers in a short time.

Education

Education of the men in the use of compressed air, applying the tool, the rate of application and the best manner of manipulating the control will reduce air consumption, encourage better work with less human fatigue and tend to lower the cost of air and tool maintenance. Much air is wasted unconsciously by men who fail to realize that compressed air costs between 4 and 10 cents per 1,000 cubic feet. That air costs money should be emphasized frequently, as only by reiterating this fact will a saving be ultimately brought about. Notices should be conspicuously posted about the plant, periodic talks should be given on the use of air, and supervision by wide-awake foremen maintained.

Records showing the maintenance costs charged against the different shops and processes, and even individuals and tools, reasons for and duration of outage, actual repairs done, etc., result in the compilation of valuable data that lead the way to improved performance and lower costs.

Induced Air

One of the greatest opportunities for economy is where air at low pressure is taken from a supply line at high pressure. Throttling from high to low pressure, as from 100 pounds to a fraction of a pound, is extremely wasteful. Under these circumstances the air syphon or injector enables a very great reduction in compressed air consumption.

The air injector, or syphon, draws free air from the atmosphere and ejects it with the air under pressure through the syphon nozzle. As the amount of air induced from the atmosphere will vary from 75 to 94 per cent., the very great saving in demand upon the compressed air system must be obvious.

During the war the U. S. Shipping Board reduced its huge consumption of compressed air in a remarkable manner by adopting the air injector. Vast quantities of high-pressure air were being consumed by the rivet forges, blacksmiths' fires and similar applications requiring low-pressure air. By means of the air syphon about 94 per cent. induced air was used and only six per cent. of the air was drawn from the high-pressure air system.

On the basis that compressed air was costing the U. S. Shipping Board six cents per 1,000 cubic feet, the saving due to using 94 per cent. induced air was $20 per forge per month. In the average industrial plant the cost of compressed air probably varies between four and ten cents per 1,000 cubic feet; but the percentage of saving would be about the same, and certainly worth while.

Water is metered, coal is weighed and metal is accounted for in its progress through the shops. But compressed air is rarely measured; instead it is used indiscriminately and often abused. One of the greatest opportunities for saving lies in the ability to meter air quite as accurately and no less expensively than water or other gases and fluids.

By metering the production and consumption of compressed air by the various shops and larger consumers, production and legitimate consumption can be checked, illegitimate wastes discovered and remedied, and abuses and misuse found and stopped. Comparatively few industrial managers or superintendents know the quantity of air consumed throughout their shops, how that consumption varies from day to day, or how much of it occurs needlessly.

The flow meter for continuously recording or for periodic surveys of the compressed air service should be as valuable as the electrical recording instruments for making voltage and power-factor surveys and similar work. The flow meter will show up things worth knowing, will put the men on their mettle, indicate deterioration of supply lines, show up pneumatic tools in need of repair and make for higher over-all economy.

Only a few points here and there have been touched upon wherein industrial plants can bring about a reduction in compressed air consumption, increase available compressor capacity by reducing wastes and costs and improving the air-compressing system throughout while lowering the cost of operation.

Compressed air is already being used in more than 68 different industries for more than 200 different purposes. The air compressing equipment of the industrial plan can get along with less attention than systems for other forms of power. But it is so important and its possibilities so great that it is certainly deserving of more attention and closer, better supervision than is ordinarily accorded it. What has been said should serve to indicate a few of the ways and suggest others in which economies may be brought about.

AGAIN—WHY THE BLUEPRINT?

It will be remembered that in our June issue of COMPRESSED AIR MAGAZINE we reprinted from *American Machinist* an article with the above title by Frank Richards. As was inevitable, the article provoked thought and discussion, the following letter by Harry Senior in the *Machinist*, July 1, being at least readable and suggestive:

The question about the blueprint raised by Frank Richards is timely and to the point. The usual roll of blueprints is an unmitigated nuisance. Every mechanic who has had to use them knows how they have to be spread out (on his neighbor's bench, for if he spreads them on his own bench there would be no room to work) and the corners weighted with sundry hammers, surface gages, squares, boxes of steel figures, drill blocks, etc., until the place looks like a pawn-broker's window in a machine-shop district.

Then, when things are nicely arranged, neighbor comes back to his bench with his hands full of junk and wants to know "what the —— —— ——!! any way?

There is but one kind of blueprint that is worse than a rolled blueprint and that is a folded one. It accumulates grease and dirt at all the creases; important dimensions become

Neighbor comes back

obliterated; it tears along some of the folds, and, just about the time a fellow gets used to it, it separates into several minor and perfectly useless prints and the round has to be started over again.

Blueprints shellbacked to a piece of heavy binder's board are perhaps the most convenient for everybody concerned, and even in this form they are unwieldy; a man cannot carry more than two at a time without a truck.

I think the post card size suggested by Mr. Richards for photographically reproduced drawings is too small. Eight by ten inches would be better for the shop, and unless a lot of prints from the same drawing are needed, the zinc plate is not necessary; direct prints on silver paper would serve the purpose.

Now don't commence to howl about the cost of silver paper. How many silver prints can be made for the price of a tracing? More than you will need probably, for the nicely mounted silver print will be taken care of, its glossy surface will repel dirt, and it will last a long time. Besides—blueprint paper is not given away now-a-days.

There is one difficulty in the way of using the photographic process to which Mr. Richards did not call attention. A drawing is seldom finished. No matter how carefully thought out was the engineer's design, there will be additions and alterations from time to time, and the combination of pencil-drawing and tracing lends itself readily to such treatment while the nicely finished original drawing does not.

However, as Mr. Richards says, the blueprint will never be discarded, and the point at which to choose between full-sized blueprints and reduced-scale photo prints would be easily decided. Perhaps it would be well to make a tracing and work from blueprints for a time until it was apparent that no more changes were to be made immediately, and then photograph.

The only difference between a drawing for a full-sized tracing and a drawing for the reduced photo print aside from inking and cleaning would be that the figures and notes should be made larger in proportion, but this would not detract in the least from the value of the average blueprint.

HOW THE MINE PUMP HAS TAUGHT THE WORLD

A concise editorial in a recent issue of *Coal Age* calls attention to a matter which many of us have little thought of, and some of us not at all; and, curiously enough, it tells us nothing that is new or not generally known. Industry has forgotten, it says, what it owes to the mine pump, yet mining with its pumping needs gave industry no less an instrument than the steam engine. Newcomen's engine, invented in 1705, was in 1711 employed for pumping mines. Not until it was applied to this purpose did it have any useful outcome. Humphrey Potter's invention for opening and shutting the valves on the engine was made on a mine pump and Henry Beigthon's plug-tree with tappets was invented in 1718 for the same purpose. Then came Smeaton, the great mine-pump builder. James Watt busied himself with a model of a mine pump in 1763.

Not until 1781 did Watt introduce the "sun-and-planet" device that turned the reciprocating motion into one of revolution and converted the mine pump into a steam engine suited for varied industrial purposes. Thus, for 52 years the mine pump led the way in the utilization of steam for power purposes. In 1769 came the discovery that steam could be used expansively and in 1782 a patent was issued to Watt covering its use in this manner. In the same year he developed the use of steam by applying it to both ends of the cylinder. From then on the mine pump became an engine for a multitude of industrial uses. Thus is the mine pump father to the factories and the factory systems of the world.

A DOOR MADE OF WIND

"Doorless doors" which keep out rain and snow and eliminate the use of screens are described in *Electrical Merchandising* (New York) by H. S. Knowlton.

They are the invention, he says, of a Boston mechanical engineer, Henry H. Cummings, who is also the inventor of the ship log which was generally installed on vessels of the United States Navy during the war. Mr. Knowlton says:

The 'doorless door' consists of a motor-driven fan installed below or behind a grill in the entrance of a store or other building and arranged to draw air downward from the upper portion of the doorway, whence it is carried by a duct to a hood at the top of the entrance and then discharged downward, completing the cycle. A quarter-horse-power motor driving a 16-in. fan and connected with a nine-to-12-in. diameter duct provides a current of air under about 3-in. water-pressure, which is unnoticed by persons standing in the doorway, but which is most effective in keeping out insects, rain, snow, and cold air. The use of the equipment enables close regulation to be made, with ease, of the interior temperature of the room, and the absence of a closed door, winter and summer, in a trial installation actually increased trade by one-third. The cost of operation is about two cents per hour."

DUST AND WATER IN SOUTH AFRICAN MINES

IN A REPORT by C. J. Gray concerning the Johannesburg Inspectorate special attention is given to dust prevention and health conditions in the mines with assurances of the beneficial effects of the regulations which have been in effect since 1917. Water to-day, it is stated, has become as essential in mining operations as the explosive used for breaking the ground. It has come to be realized, thanks to the advent of the Kotzé konimeter, that dirty water, especially when used with machines where atomization takes place, is nearly as harmful as none at all. Consequent upon this has come the necessity, with the huge volume of water used to-day, of devising means whereby the same water is used over and over again. A considerable amount of experimenting with new types of water-feed drills has been done in the mines in this district. As the result of prolonged experimenting, a simple, and what would seem an extremely promising, water-feed has been turned out. The great advantage of this water-feed is that it can be attached to any reciprocating machine, and for a cost locally of £10 per machine. An Australian invention on similar lines, known as the "Swift" attachment, has been tried on piston drills on one or two mines in the district, and with considerable success; large numbers have, however, not been equipped, mainly, presumably, owing to the present high price. There has recently been put on the market a so-called "wet jackhamer," which is virtually a small Leyner type machine. One of the outstanding features of the year's work is the adoption of the jackhamer drill on nearly all mines in the district. At the end of 1917 only one or two mines in this district were using this type of machine for stoping; at the end of the year there were 600 drills at work. The main reason for the adoption of the drill has undoubtedly been the shortage of native labor, the average fathomage broken per machine shift with one of these machines, with one boy per machine, being equal to that which would be broken in the same stope by five to six hammer boys; on some mines this figure would be considerably higher.

Ventilation of the World's Deepest Mine

IN THE discussion of the report of the committee on working conditions in hot and deep mines, which was presented at the meeting of the Institution of Mining Engineers held at Birmingham recently, and published in the *S. A. Mining and Engineering*, Eric Davis gave some particulars of the problem at the Morro Velho gold mine of the St. John del Rey Company, in Brazil. As is well known, this mine is the deepest in the world, the lowest working being 6,400 ft. vertically below the surface and 3,650 ft. below sea level. Luckily the rate of increase of rock temperature with depth is considerably less than that indicated in the report as being usual. Whereas the report gave 1 deg. F. for every 70 ft., at Morro Velho it is only 1 deg. for every 140 ft., although there are indications that the rate is increasing slowly for increased depth, so that for the lowest 2,100 feet the rate has been about 1 deg. for every 119 feet. In the year 1913 Mr. Davis was entrusted by Mr. George Chalmers, the superintendent of the mine, with an investigation into this matter with a view to overcoming the difficulties and rendering the mine workable at depths considerably greater than those which had been reached. The only instruments he had were an aneroid barometer and wet-bulb and dry-bulb thermometers. Readings were taken at every level right down through the mine, and the results were plotted on diagrams having depth in feet for base. It was found that the dry-bulb temperature at any one point in the mine remains practically constant all the year round, but that the wet-bulb temperature undergoes considerable variations. For the same dry-bulb temperature and barometric pressure the wet-bulb temperature depends on the moisture content, and the tests he took showed that—the conditions being equal, and the mine being a dry one—the moisture content at any point underground, and therefore the wet-bulb temperature at that point, depends almost entirely on the moisture content of the surface air entering the downcast shaft. The whole question therefore boiled down to finding by analogy from the diagrams that volume of the entrance moisture contents which would give wet-bulb temperatures in the working zone below what had been fixed upon as the limiting value, corresponding to the 80 deg. Fahrenheit mentioned in the report. Then the temperature at which the air when saturated with moisture would have this required initial moisture content was that to which the downcast air would have to be reduced before it entered the mine. By hourly hygrometric observation at the surface, extending over a whole year, the worst conditions likely to be reached by the surface air became approximately known. Hence, knowing the volume to be dealt with, the amount of refrigeration necessary, power required, and so on, could be calculated. It was found from the diagram that in order that the wet-bulb temperature in the stopes should not exceed 82 deg., which they had fixed upon as the maximum desirable, the initial moisture content must not be more than about 50 grains per lb. of dry air, corresponding to a saturated condition at 45.5 degs. F. The plant now being erected was mainly manufactured by Messrs. J. and E. Hall, Ltd., of Dartford, and was capable of eliminating about 100,000 B.T.U. per minute. This corresponded to the cooling of the volume of air, 80,000 cubic feet per minute, from an initial wet-bulb temperature of 72 degs. (slightly below the maximum actual condition) to 43.5 degs., so that it was on the safe side. As the surface wet-bulb temperatures varied during the year between 75 degs. and freezing point, 32 degs., it is obvious that the refrigerating load on the plant would be a very variable one. To meet these conditions they were dividing the plant into six stages, each complete with its own motor-driven ammonia compressor, condenser and evaporator. The number of those sets running at one time would, of course, depend on the initial temperature conditions. The air cooling would be accomplished indirectly, as it would be deadly to have ammomia mixed with the entering air. Therefore, the ammonia would be used to cool water, which in its turn, would cool the air as it passed through the Heenan air coolers. The whole plant is on the surface and deals with the downcast air before it enters the mine at all. The mine is absolutely dry, and, therefore, there is no fear of any great amount of moisture being picked up by the air in its course. The plant now being installed will cost about £50,000, and the power required is about 500 h. p. Provision is made for the addition to the original six stages of three further stages in case they should go deeper and still further cooling be required.

TRADE WITH CHINA FAST INCREASING

The great commercial awakening that has taken place in China shows no sign of abating and American manufacturers are beginning to recognize that in China lie greater opportunities probably than anywhere else in the world. For the fiscal year ending June 30, 1914, the United States imported nearly $40,000,000 and exported $25,000,000 worth of merchandise; but in 1919 our imports had jumped to over $145,000,000 and the exports to nearly $110,000,000.

There is almost no limit to the potential trade of China, naturally so rich and so thickly populated. Although she has coal enough to last the world more than a thousand years her deposits have hardly been touched. Great areas of rich wasteland are awaiting irrigation and cultivation. Given fair means of transportation and a stable government, China would soon have a tremendous surplus of raw material for export. There are many articles that the Chinese would take from us in enormous quantities, could they only be made known to them or could cheaper means of transportation to the interior be developed. The market for machinery of all kinds is practically unlimited.

WATER-BLAST IN SOUTH AFRICAN MINES

THE ACCOMPANYING sketch and photo of a portable water-blast successfully employed in several mines on the Witwaters—rand for dust prevention have been sent to *Engineering and Mining Journal* by the firm of Robertson & Moss, the originators of the device. It is patented only in South Africa.

The blast is primarily intended for use in winzing, as it uses only thirteen gallons of water; thus, no trouble is experienced from flooding when work is resumed, nor is there excess of water to be pumped to surface. The tank, which is preferably made from a three-

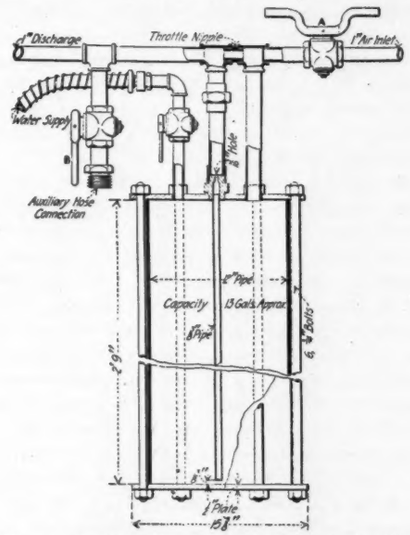


Fig. 1.—Details of Robertson & Moss water blast.

foot length of twelve-inch piping with dished plates riveted in the ends, may be placed in the drive, out of harm's way, as it has been found that the blast will operate efficiently with a 500-foot length of one-inch piping.

The miner when going on shift fills the tank with water. After he has lit up for blasting, he turns the valve controlling the air pipe, which is required by law to be led down the winze for dispersing fumes. This pipe extends to within 50 feet of the face and is the only part of the contrivance exposed to the

Fig. 2.—Water blast at Simmer & Jack Mines.

blast. The valve admits compressed air, which by means of the injector and ejector action, easily understood from the print, atomizes the water and delivers it at the bottom of the winze. It has been found that the blast works satisfactorily with air pressures varying from 80 to 20 pounds per square inch.

Air-Lift Supersedes Reciprocating and Centrifugal Pumps

By Edward E. Wall*

WHEN THE intake tower and tunnel of the St. Louis water-works was built at the Chain of Rocks more than 25 years ago, the tunnel was connected at the river bank with a pump-pit shaft constructed for the purpose of installing at some future date pumps for unwatering the tunnel. About 10 years ago the great difficulty in obtaining a sufficient supply of water through this tunnel at seasons of low water gave rise to the belief that the tunnel was in some way obstructed. In 1911 it was decided to make a serious attempt to unwater this tunnel. An 8-in. pump was installed, but failed at any time to pump the guaranteed quantity of water. It was then decided to install in this shaft a motor-driven centrifugal pump, completed in 1913.

In building a new intake and tunnel, which was completed in 1915, a connection was made to the same pump-pit shaft, so that the new tunnel might also be unwatered by the same motor-driven centrifugal pump. The capacity of the pump was 4200 gal. per minute, with maximum lift of 84 ft., diameter of suction 12 in., diameter of discharge 12 in., speed 1200 r.p.m., efficiency 70 per cent, horsepower required for this duty, 117. The pump unit complete was mounted on an elevator platform which was lowered and raised by means of a hand-operated windlass. The discharge from the pump was connected to a 12-in. stationary discharge pipe at intervals of 12 ft. from El. 34 to 94, by means of a flexible hose.

In the autumn of 1916 the well was pumped out and the gate was opened to the new tunnel and, because of difficulties in operating the gates, connecting and disconnecting the pump discharge, temporary breakdowns, etc., it was seven days before the new tunnel was unwatered. During the same season an attempt was made to unwater the old tunnel, and after seven or eight hours' work the water was only 10 ft. lower than the water in the river, and the idea of unwatering the old tunnel with this pump was abandoned. The discharge at this time was found to be 2200 gal. per minute, the falling off in capacity being due to the wearing of the impellers and the slowing up of the motor due to changes in the winding.

In 1917 various schemes were proposed for unwatering the tunnels; among them was an air-lift pump. In 1918 a design of a two-stage air-lift pump was made with a capacity of 3000 to 4000 gal. per minute at a maximum head of 76 feet. The first lift was from El. 22 to El. 49.6, and the second from El. 48.6 to El. 98. A 55% submergence was decided upon. This submergence required an excavation in the bottom of the pump-pit shaft 32.5 ft. deep and the building of two 42-in. concrete wells from the bottom of the excavation to the bottom of the overflow boxes, at El. 45.6 and 94, respectively.

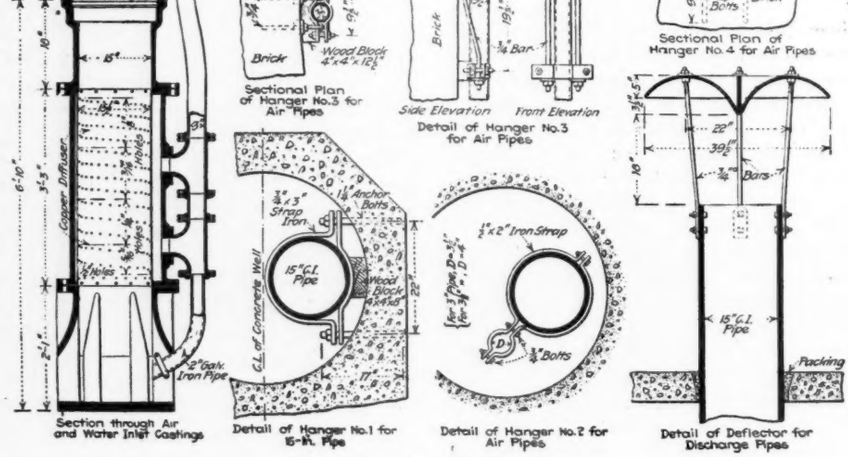
The work was done in January, February and March of this year. Fifteen-inch bell and spigot discharge pipes were placed in these wells, and special footpieces and air diffuser were provided. The air is carried through a 3 and 3½-in. pipe to the first and second lifts, respectively. These pipes were connected to a 5-in. air line about 550 ft. in length leading to an air compressor in the boiler room.

The estimated air required for 3000 gal. for both stages was 1950 cu. ft. per minute. The compressor used for this work was a compound machine having a piston displacement of 2450 cu. ft. per minute acting as a two-stage compressor and 3333 cu. ft. per minute acting as a twin single-stage compressor at 100 revolutions per minute.

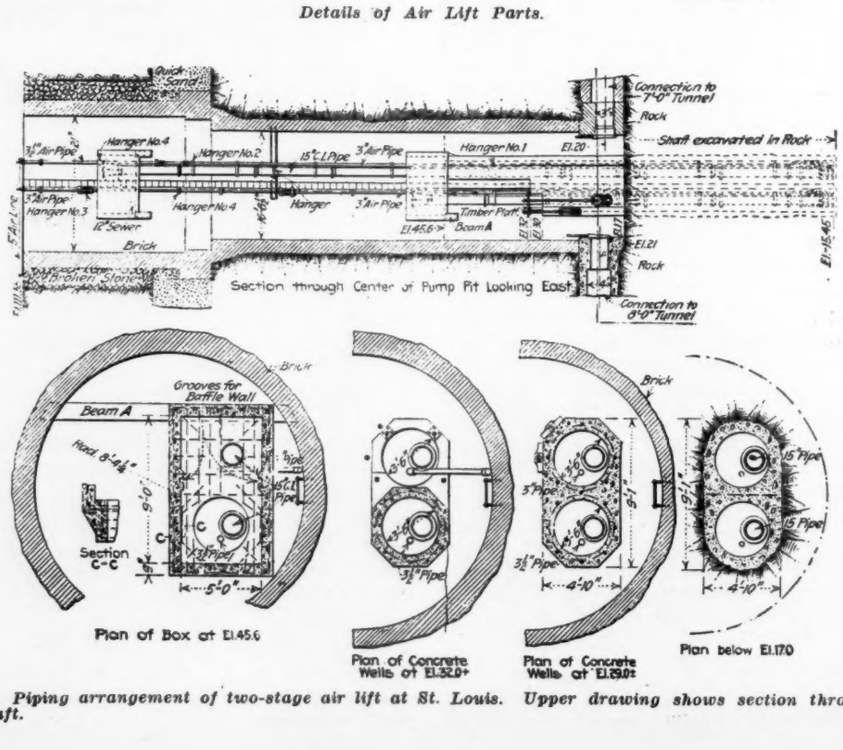
The cost of the air-lift pump and installation was as follows:

Air compressor	$4,215 92
Erecting	899 41
Pipe line and laying	1,376 89
Shaft excavation	2,389 11
Concrete wells	3,351 80
Building	594 05
Cast-iron pipe, etc.	590 62
Miscellaneous	753 44
Total	$14,171 24

During the first week of August the new tunnel was unwatered in seven hours. On Aug. 30 the gates were closed at the ends of the old tunnel and the air pump was started, and in six hours the tunnel was dry for the first time since it was built. The operating of the air-lift was very satisfactory. The flow of


Section through Air and Water Inlet Castings
Detail of Hanger No.1 for 15-in. Pipe
Detail of Hanger No.2 for Air Pipes
Detail of Deflector for Discharge Pipes
Sectional Plan of Hanger No.3 for Air Pipes
Detail of Hanger No.3 for Air Pipes
Sectional Plan of Hanger No.4 for Air Pipes

Details of Air Lift Parts.


Section through Center of Pump Pit Looking East
Plan of Box at El.45.6
Plan of Concrete Wells at El.32.0+
Plan of Concrete Wells at El.29.0±
Plan below El.17.0

Piping arrangement of two-stage air lift at St. Louis. Upper drawing shows section through shaft.

*Water Commissioner, St. Louis, Mo. Article condensed from Eng. News-Record.

water was steady, and the absence of a gush of air, followed by a gush of water, as usually observed in a high-lift pump, was gratifying. This condition was always maintained until the water was almost exhausted and the flow of water to the pump became much less than the capacity of the air lift, when the gushes of air and water commenced.

An examination of the old tunnel proved it to be in excellent condition, the fabled leak being nonexistent and all fancied obstruction of no consequence.

The air-lift pump was designed and built under the general direction of the water commissioner, the details of design and construction being under the direct charge of C. M. Daily, engineer-in-charge supply and purifying section. The accompanying cuts show interesting details of the air-lift installation.

USED EXPLOSIVE CONTAINERS ARE DANGEROUS

The Bureau of Mines sends out a warning concerning the careless disposal of explosives containers. It says:

Although used explosives containers are so generally put to beneficial service, there is nevertheless an element of danger in their use. Dynamite boxes are particularly dangerous. Frequently nitroglycerin exudes from the dynamite sticks and is absorbed by the wood of the box. Such boxes are dangerous because they are explosive. Although a box that has not absorbed nitroglycerin is safe, yet there is always the danger that a person will get a box that is partly saturated.

The boxes that have been condemned, together with the paper linings of all boxes, should be burned in a place sufficiently removed from all buildings, preferably in a deep hole or behind an earth barricade. The boxes can be ignited by using an electric igniter or a fuse of appropriate length to spit fire into oily waste or excelsior.

Care should also be exercised in the disposal of black blasting powder kegs in which loose powder has been shipped. It is difficult to get the last few grains and the dust of black powder out of the keg, and serious accidents have occurred by these kegs coming into the possession of children and others unacquainted with black blasting powder. All used black blasting powder kegs should be thoroughly washed with water before giving them away or putting them to use.

COSTLY MAIL TUNNEL TALK

When the Senate and House conferees agreed on the Post Office appropriation bill, it contained a provision for a commission, which is to study among other things, the advisability of establishing a system of tunnels to handle mail in congested centers—especially in New York City. The commission is to consist of a chairman and four members of the Committee on the Post Office and Post Roads from both the Senate and the House and a postal expert appointed by the Postmaster-General. This commission is to have authority to appoint an advisory council of seven to be composed of those having special knowledge of the work in hand—preferably representatives of commercial organizations, and engineers who are acquainted with existing conditions and requirements. Further, the commission is authorized to employ such engineers and special experts as it is deemed necessary to assist in its investigation.

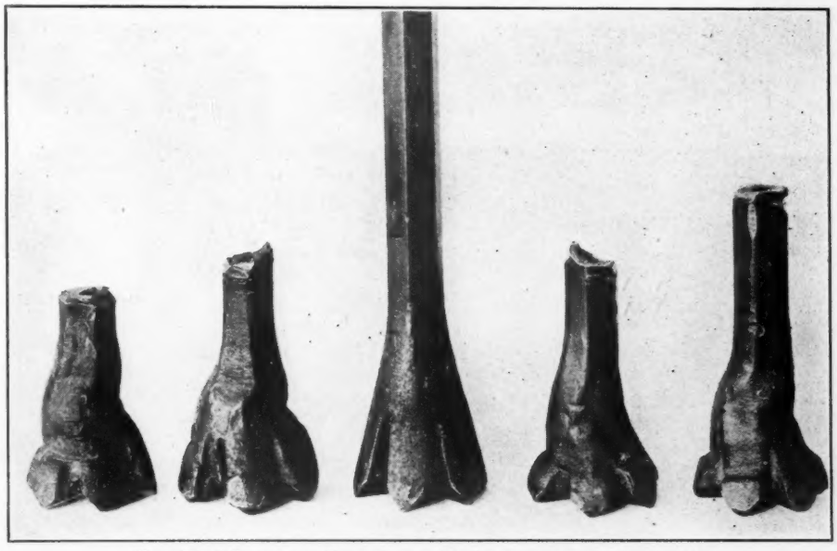
THE BLACKSMITH AND GOOD DRILL BITS

By D. E. DUNN

Manufacturers of rock drilling machinery can and do make good rock drills and drill steel sharpeners. However, they can never eliminate the personal equation of the blacksmith. It would seem that the most uninformed persons would realize that the success in rock drilling is almost entirely dependent on the blacksmith turning out good steels. The drill steel sharpener has gone a long way toward improving the quality of bits made; however, even with this improved and special machine proper bits can be made only with a little care and judgment on the part of the blacksmith.

One of the largest manufacturers of rock drilling machinery not long ago had a complaint that one of its Jackhamers was falling down on the job; in the customer's own words—"The drill didn't have any pep." One of the company's representatives investigated this case and the accompanying photograph shows the actual condition of the bits that were used in this mine. The bit in the center was made by this representative with the same machine as the other four bits shown, demonstrating clearly that it was not the fault of the sharpening machine. Is it any wonder that the Jackhamer didn't have any pep?

It is found that a large number of drill complaints can be traced directly to bad blacksmithing against which the manufacturers are waging a continual campaign of education. It illustrates also the problem that the representatives of mining machinery companies are frequently confronted with, that is, complaints and dissatisfaction of sincere but not thoroughly informed operators.



Showing different results secured with the same sharpening machine.

SYNTHETIC AMMONIA

A press disptach from Rome announces the production of synthetic ammonia by Dr. Casale, prominent in the Italian chemical industry. The process involved, it is stated, requires neither coal nor any other material but air, and works automatically through the operation of special machinery and a novel chemical reagent. A mixture of nitrogen and hydrogen is forced through catalyzing tubes at a pressure of 250 atmospheres with the positive results of transformnig the two gases with pure ammonia. It is said that Dr. Casale has already installed a plant which produces one ton of ammonia daily but expects soon to employ much larger units. He is talking of providing Italy with 300,000 tons of ammonia yearly for fertilizers with a large surplus for export.

THE STEAM SHOVEL

By LYDIA M. D. O'NEIL

[In *Popular Mechanics*]

After the bidding is over and done,
After the fight for the contract is won,
And the chief engineer to the starting point comes
With all the details at the ends of his thumbs,
And the big Irish bosses arrive on the scene,
Lips lovingly locked on the faithful dudeen,
And the navvies assemble, their wages to win,
It is time for the steam shovel's work to begin!

From Culebra Cut to the far Simplon,
I have groped in the depths of earth;
From the Jersey flats to the steep Cajon,
I have proven my lasting worth!
Railroad, tunnel, canal, or mine—
When all is completed at length,
It stands as a proof of the genius of man,
And proof of the steam shovel's strength!

The dust of the desert or swamp soil moist,
Alike shall I gather, alike shall I hoist;
I shall move a mountain or change the course
Of the river that taunts you with furious force.
I shall deepen the harbors and widen the fills,
And gouge you a path through the heart of the hills,
Extend you the margins of whimpering seas,
And laugh in the matching of power with these!

From Port Sudan to the far Cascades,
I shall go where the blueprints lead;
From Ningpo-fu to the Everglades,
As the contract's terms may read.
Railroad, harbor, canal, or mine—
When all is completed at length,
Let it stand as a proof of the cunning of man,
And a proof of the steam shovel's strength!

AIR LIFT SYSTEM OF RAISING OIL AT BAKU WELLS

By ROLAND H. BRIGGS
British Editorial Correspondent

AN IMPORTANT paper on the pumping of oil wells was read by Mr. R. Stirling before the Institution of Petroleum Technologists in London recently. The author did not deal with the air-lift as a general system of pumping, but only in its application to oil wells. The air lift system depends for its action on the aeration of the discharge column of liquid. The weight of this column must be lighter than the column of liquid in the well, so that no additional pressure can be put on the strata in the well. Thus there is no foundation for the argument that the compressed air will drive back the oil into the oil sands or into other porous strata.

The air lift, properly applied, is the most advantageous method of raising the oil from all wells yielding sufficient liquid for the continuous working of an apparatus of the smallest practicable capacity. It is particularly advantageous for wells which have ceased to flow naturally, and either flow intermittently or not at all, because by the air lift much larger yields can be obtained than by any other system of pumping. Any gas present with the oil assists the air lift by reducing the quantity of air required, and the energy of the gas now wasted is thus utilized. Where the oil is found in loose sands which enter the well with the oil, the air lift is the only practicable means of raising the sand with the oil, and so keeping the well always clear to the bottom, and thereby securing the maximum yield from the well.

If screens are used to prevent the sand from entering the well, the mud and fine sand will pack outside the screen and become impermeable to the oil, which is too viscous to keep the screens clean as water will do. The sand cannot be extracted by and interferes with the working of the ordinary well pump, which must be located well away from the bottom so that the bulk of the sand may settle below. The accumulation of this sand prevents free flow of oil to the well, until the yield is so diminished that the pump has to be withdrawn and the sand removed by means of a sand pump. In addition to its other disabilities the ordinary oil well pump is less efficient than the improved air lift apparatus.

The only alternate method of raising the sand with the oil and so keeping the well clear is the cumbrous and uneconomical bailing system developed at Baku, which necessitates large diameter wells for even moderate production. The use of compressed air for periodically blowing the oil as applied in Texas in 1901, and similar displacement systems, are not economical, and had other disadvantages, which tended to discredit the use of compressed air for pumping oil wells.

The systematic application of the air-lift system in Baku began in 1901, and several wells were equipped. The first was 1358 ft. deep, and the oil stood at 600 ft. from the surface. The first well in previous years had a daily production averaging 1200 poods, but with the air lift this output was increased tenfold in the following six months. The oil was taken from below the casing shoe, the compressed air being introduced higher up, the working pressure ranging from 110 to 160 lbs. per sq. in.

The depth of the second well was 1414 ft. and the liquid level 595 ft. from the surface. The well had flowed, but only a small output could be obtained by bailing as the casing had been damaged. The air lift raised from 7000 to 8000 poods per day and the well was still producing in the middle of 1903. Several other wells were also satisfactorily equipped with air lift apparatus during 1901.

Over 50 damaged wells or wells flooded with water were experimented with from 1901 to 1904, and it was proved that an air-lift will not damage a good well, although it may aggravate defects in a bad well. It has been suggested that by increased production the oil level may be lowered to such an extent that the casing will collapse. But as increased production will in any case subject the casing to this additional strain, and a similar effect will be caused as the well becomes dry, this extra pressure on the casing cannot be avoided, and the casing was not collapsed or damaged in any of the wells tested, although in some cases the liquid level was lowered by several hundreds of feet.

Another objection raised to air-lifts is the inflow of water induced by them, but although when pressure is removed from the liquid bearing strata, the liquids will enter in increased quantities if they have access to the casing, both water and oil will be in the same proportions as before, and the greater production of liquid obtained by the air-lift will carry a similar proportion of oil to that in the lesser production obtained by other means.

If the entrance of one of the liquids is restricted, as when entering through a defect in the casing, then the liquid which has unrestricted entrance will increase in much greater proportion, and if this is oil the shutting off of the water may be unnecessary.

Only one disadvantage has to be recorded against the air-lift. With very heavy viscous oils with from five per cent to twenty per cent water content, an emulsion may be formed from which it is difficult to separate the oil. This trouble did not occur with wells containing less than five per cent of water, and where the water content was from ten per cent to fifteen per cent, the difficulty was surmounted by running an additional twenty per cent of water into the well. No extra expenditure of air was required to raise the added water owing to the way in which the discharge was facilitated and increased.

It was at first feared that the air might carry off some of the lighter constituents of the oil, but the refineries reported that if anything the oil raised by air-lift retained a greater proportion of the lighter fractions, probably owing to the slight refrigerating effect of the expanding air. The initial successes at Baku were not followed up owing to the disturbances caused by the Japanese war, to unsuitable apparatus subsequently used, and to erroneous conclusions with regard to the results obtained.

The loose sands in some of the oil fields of Trinidad led to the introduction of the air lift system there. The conditions met in these wells are similar to those in Baku, but application is simpler owing to the use of screwed casing and the rotary system of drilling. These make it possible to control the wells during the eruptive stages, and to apply the air lift as the general system of pumping the wells. While the general success of the system has been established, the unsuitability of some of the existing types of oil well apparatus has been demonstrated, and some unexepected conditions have been revealed.

In one case the air-lift ceased to work properly, and it was found that the drill stem was perforated in various places corresponding to the standard pitch of the perforations in the casing. This showed that when the liquid level was lowered, the oil and sand were being driven through the perforations by the gas with the velocity of a sand blast. It was therefore clear that the casing perforations should be much larger or much nearer together, to allow a free flow of the oil.

From the results obtained at Baku the author considers that it may be accepted almost as an axiom that every well which cannot be pumped dry by the pumps in use, could be made to give a greater yield if pumped by air-lift, lowering the liquid level, and keeping the well constantly clear to the bottom. An exception might be when the oil enters the well only from a higher sand, or when an unmanageable quantity of sand is brought in, or when dangerous disturbance might be caused to the strata. The addition of a valve at the bottom of the air-lift discharge pipe is a vital improvement, which makes the system applicable to wells containing loose sand, without frequent choking of the pipes by the occurrence of sand.

Such a foot valve (U. S. A. Patent, 1,279,783), can be fitted to the rotary system drill stem, and enables a well to be drilled into an oil-sand with gas under high pressure, so that an unrestricted flow and strata disturbance can be prevented, and the flow, now generally interrupted by the choking of the pipes with sand, can be maintained continuously by air-lift apparatus. If the flow is restricted from the start, much less sand will be removed, and the steady flow tends to assist the formation of channels in the sand draining a large area round the well.

The air regulator and meter valve, assists the pumping of water and oil wells in groups, and the supplementary starting nozzle prevents the necessity of maintaining a wasteful pressure in the air main when starting, the liquid level of which rises when standing very much higher than the level it maintains when pumping is in progress. Another improvement in air-lift apparatus specially adapted to oil wells is a foot-piece or air nozzle designed to obtain a thorough air and liquid mixture, without excessive slippage which occurs when there is gas in the oil.

The author described and illustrated a suitable air-lift equipment for pumping oil wells, and explained its method of operation. The drill stem with bit and back pressure and

sleeve valves is lowered into the well, and oil having been reached sufficient water or oil is pumped in to clear the drill stem of mud, the discharge pipe is then lowered with the air nozzle and screwed into the sleeve valve, and the air discharge connections made. The pressure air is then admitted, the sleeve valve lifted, and the discharge commences.

In conclusion the author points out some of the main advantages of the air-lift system as applied to oil wells. The relative position of the wells is immaterial so long as they can be reached by the compressed air system. A central power station may be installed for the sake of economy and all the wells fitted to work at approximately equal air pressures. No system requires less attention and supervision, but the latter must be by technical men because the results do not merely depend on the apparatus. Modifications must be made to suit the individual conditions of each well, to give the highest output. The greatest production will be obtained after a careful study of the existing conditions, and the arrangement of a suitable depth of drilling and the like. The cost of production is much the same whether the output is large or small, so that every extra barrel obtained by better methods is a direct gain. The air-lift system of pumping oil will raise all the oil the well will yield, and will keep the well clear and in the best condition for yielding.

ADAPTATIONS OF COMPRESSED AIR TO DIESEL ENGINE

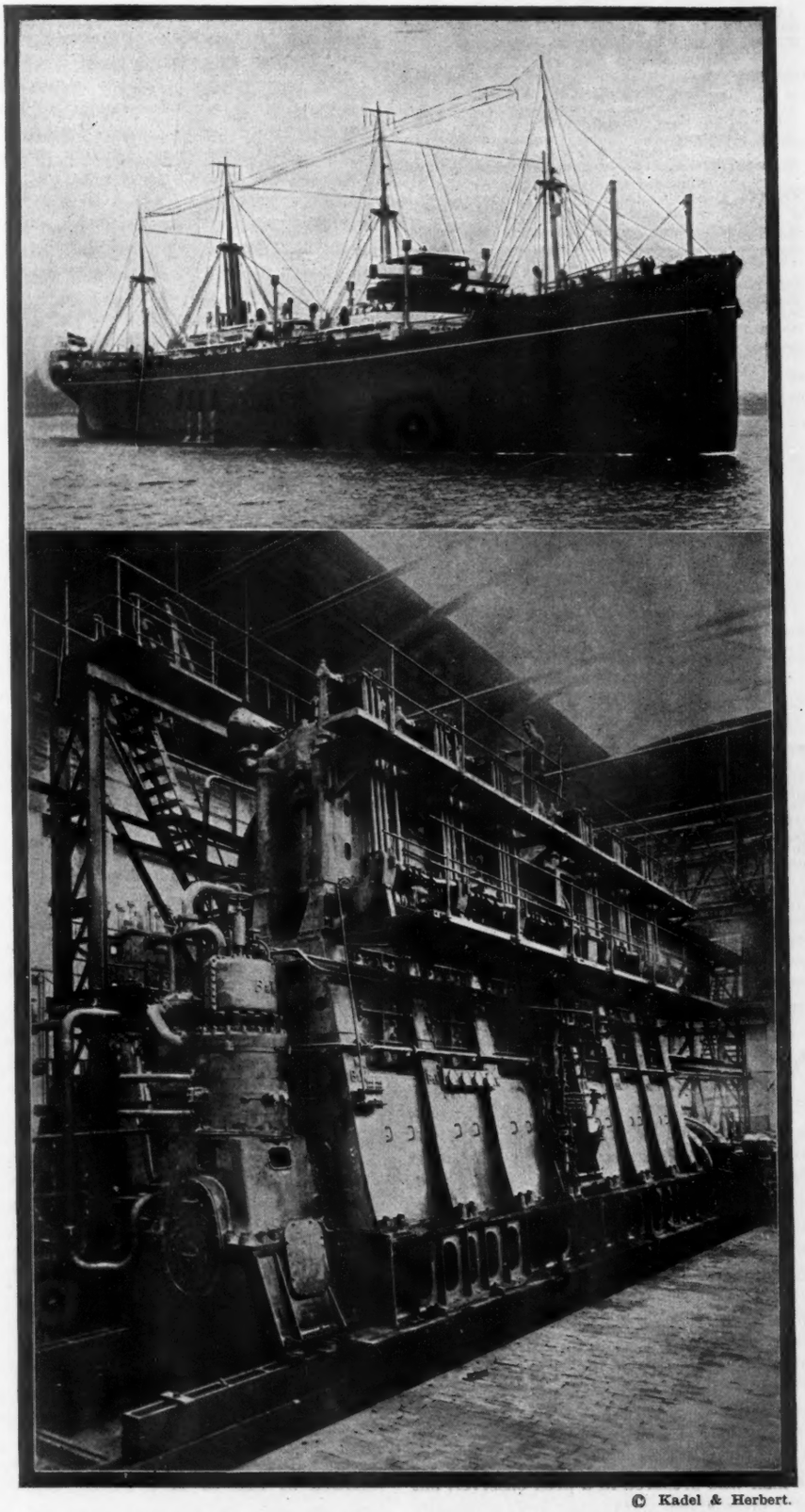
By S. F. ARMSTRONG

THE MOTORSHIP is the most economical type of cargo carrier. Not only is its cargo carrying capacity greater than that of a steamship of the same displacement but the cost of operation is much less on account of the lower fuel consumption, low water consumption and the reduced engineering complement.

The factor that makes possible these many advantages is the Diesel engine. The Diesel engine is simply an internal combustion engine using crude or bunker oil as fuel and obtaining its ignition by means of the heat of compression.

Compressed air plays an important part in the starting and running of the Diesel engine. In starting it is necessary to give the engine a few initial revolutions in order to raise the temperature to a point where it will ignite the fuel. This is done by means of compressed air. While running, the fuel is injected into the working cylinders by means of spray air at a pressure of 800 to 1,000 pounds per square inch. The air, both for starting, maneuvering and injection is provided by a three or four-stage air compressor built integral with the engine, and driven by a crank off the engine's main crank shaft. The air from this compressor is led to a battery of air bottles known as the spray air bottles and maneuvering air bottles, and it is from these that the injection air and maneuvering air is drawn.

Compressed Air on Board the World's Largest Motorship, the "Afrika."



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The upper photograph shows the world's largest motorship, the "Afrika," afloat after her recent launching and at the time of her successful trial runs. This splendid new type of ship, without funnels, was built for the Great East Asiatic Line of Copenhagen. The vessel has no steam boilers or steam equipment of any kind on board, being propelled by twin Diesel type internal combustion motors, using crude oil for fuel, all of her accessory machinery such as the winches and pumps being electrically driven. Her generators also are operated by smaller type Diesel engines.

The lower photograph shows the huge internal combustion motors that drive this great motorship, an air compressor being shown in the foreground directly hooked up with the main shaft.

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Correspondence invited from engineers, chemists, experimenters, inventors, contractors and all others interested in the applications, practice and development of compressed air. Correspondents and contributors will please submit questions, or matter for publication, accompanied by self-addressed stamped envelope; they also will please preserve copies of drawings or manuscripts as we cannot guarantee to return unavailable contributions in the event of rejection, though our practice is to exercise diligence in doing so.

EDITORIALS

THE RESULTS OF RUSSIA'S COMMUNISTIC EXPERIMENT

NO MORE realistic, but at the same time no more distressing narrative of industrial and social existence as it is in Russia today, has reached this country, than that contained in the absorbing article published in this issue of COMPRESSED AIR MAGAZINE. A perusal of it makes the most hopeful, and the most sincere well-wisher for the ultimate welfare of the Russian people sigh with doubt regarding the future prospects for those condemned to live amidst conditions of enforced idleness, or at most mere pretense of wholesome employment, whilst battling feebly against disease, vermin, filth and death. Death in many instances, it appears, would be a welcome relief.

The editors of this journal are fully advised of the reliable source of this information, as the man who prepared it, a keen observer, but not a professional writer, has been personally known for years by responsible New York business connections. His temperate account presents only statements of fact, not theories, and pretends to make no deductions. He perhaps wisely refrains from any predictions respecting the outcome of the social experiment of LENIN and TROTZKY and their fellow leaders, and their willing and unwilling followers. But the thoughtful reader can perceive the fast approaching finale of this wildest of governmental ventures in the world's history. Such conditions cannot for long be supportable.

We wish that every amateur bolshevik, every parlor anarchist, every radical socialist, every member of the I. W. W. in this country, who stand for principles similar to those promulgated with such terrible results in Russia, might read this article with a fair and open mind. It might do more to stay their foolish imaginings, to offset their impractical and false reasoning, than methods of suppression.

One cannot help but inquire in what case the *soviet* ark deportees find themselves. How do EMMA GOLDMAN and her companion, ALEXANDER BERKMAN, and others who were expelled from America, with all its material and spiritual blessings, its freedom of moral action within decency, and its protection, find this ghastly "utopia," this much-lauded social criterion, this dream of Elysium?

Well! Let us listen to a tale of sorrow from Petrograd, "and one poor heart breaking," as phrased by the *New York Times*. It comes from Miss GOLDMAN, weary of Russia her own, her native land. For six weeks she has been in the home of the exploited proletariat; six weeks she has been exposed to the free and joyous movement of the triumphant applied Marxism. Here is what this well known, time-tried exponent of radicalism has to say:

"It is rotten. So rotten I am sick with it. Socialism in Russia has taken away even the little freedom the man has under individual capitalism and has made him entirely subject to the whims of a bureaucracy which excuses its tyranny on the ground it is all done for the welfare of the workers."

Here is disillusion, with the long-time dream of this "gracious friend of humanity" broken and destroyed and lost "the beloved idea of her soul." She and BERKMAN left America cursing the land that had kept even these dangerous agitators in affluence. BERKMAN was related to have boarded the *Buford* carrying a comfortable fortune with him. It is to be hoped that this country will remain well rid of them, even though they threatened to come back one day and set up a *soviet* government right under our very noses. These people made their own places of repose, infested with vermin though they now may be. We cannot welcome them back, though, as the *Times* says, it does add a bitter vividness to our conception of the horrors of the dictated proletariat to think that even EMMA GOLDMAN finds them intolerable.

The GOLDMAN apostasy from Bolshevism was followed by that of Mrs. PHILIP SNOWDEN, who has been described as long the high priestess of the cult of the LENIN lovers of Great Britain, and one of the socialist-pacifist type which hates war—except when it is waged by noble champions of destruction, assassination and chaos. Mrs. SNOWDEN went to Russia as a member of a British labor delegation sent to investigate the *Soviet* idea in its lair. She underwent a drastic, even an heroic, but nevertheless an effective cure. Facts pried the prepossessions out of this seasoned radical.

LENIN was urbanely gracious to her, TROTZKY smirkingly polite, and "the stage work was up to standard," but Mrs. SNOWDEN was not to be deceived by the trappings at headquarters; she was of too inquiring a nature. She found conditions absoluetly insupportable by decent folk, whether capitalists or radicals, or in-between moderate socialists. She looked for democracy and found autocracy; for some semblance of socialism and discovered a system of forced labor far worse than capitalism; she looked for freedom and gazed on abject slavery. She found that the phrases of LENIN are different, but that his methods were those of a Mongolian despot. His communism was a fraud, even if it were ever conceived in sincerity, and a meagre minority ruled by the terror of the firing squad. The investigator returned home with her delegation to report that *Soviet* Russia could teach the western world nothing. But it does teach something: it teaches what to avoid. The "contemptible middle class economists" predicted that Bolshevism would stop production and it did, with grievous results.

Even the Russian workmen, one learns from Reval, are finding conditions unendurable. The Social Democrats of Petrograd have sent out the following statement to all of their faith throughout the world, via their fellows in Esthonia:

"Russia is drenched in blood. The Communist Government has destroyed all social and industrial life, tramples personality into the dust, and has already annihilated the best intellectual power of the land. To foreign nations the Bolshevik pretend to be representatives of the workers and peasants, but they trick the masses of the people and give promises only that they may keep themselves in power. Only through shameless methods of violence do they remain in control, and every day their real hatred against the laboring men becomes more apparent. Through many imprisonments our Social Democratic organization is being destroyed, and the methods are like those of the Czar. Spies are everywhere, and many Social Democrats are continually brought to trial. We, the workers representing fourteen factories of Petrograd and the Social Democrats of Petrograd, protest loudly against this challenge to the whole of the working class in Russia. We have nothing in common with this Government of violence and murder, and we pledge ourselves to use every means that this report shall reach across our frontiers to comrades in other countries."

Disregarding such testimony as the foregoing is merely perverse and fatuous.

Mr. JOHN ALLYNE GADE, an architect, who was formerly president of the American-Scandinavian Society, resigned his post as United States Commissioner in the Baltic Provinces recently and upon returning to America testified that the few American newspaper men who have been permitted to enter Russia have

been unable to write of the actual conditions under *Soviet* rule. They were allowed to see only what the communists wanted them to see. Their dispatches were censored and they were virtually prisoners while in Moscow. He said, however, that the American Department of State had been accurately informed of what was transpiring in Russia.

Mr. GADE declares that if the Allies and the United States refrain from making any trade arrangements with *Soviet Russia* for another three months that the Bolshevist regime will be forced to a collapse through paralysis of transportation. The Bolshevik emissary, KRASSIN, has been negotiating in England, while MARTENS has been negotiating in Canada, and with some success, having failed of support and comfort at Washington. Meantime the manhandlers of Russia appear to be approaching some sort of a climax.

Were it needed, further confirmatory evidence of the situation in Russia is provided by the Rev. F. W. NORTH, a British chaplain at Moscow during the revolution and the terror. Having lived ten years in Russia, he is qualified to understand and interpret events. In the London *Morning Post* he has been publishing a series of articles in which he described the All-Russia Extraordinary Committee, the power which is actually in power in Russia today. It is a secret police, exercising the power of confiscation of property and of life and death over individuals. This power even exerts itself, on occasion against LENIN and TROTZKY. A man named DERJINSKY is its chief. This body can arrest, condemn and execute anyone without trial. It is this power which really rules "in the midst of chaos and destitution."

A perusal of our stirring article out of Scandinavia should strengthen the resolve of every loyal American who reads it to combat with all his moral strength, with all the weight of his individual influence, every indication, from whatever source, of social radicalism. Our sensible workmen, our foremen, our managers in the industries, have before them in present-day Russia an example of misguided political effort so vivid in its horrible results, that they may bless the stars of the banner under which they find a kindly and paternal protection for every essential of their earthly happiness and well-being.

SHALL INDUSTRIAL DEMANDS ON WATERWAYS BE MET?

OUR ALWAYS interesting and dynamically active editorial contemporary, Mr. FLOYD W. PARSONS of the *Saturday Evening Post's* department, "Everybody's Business," who formerly held down the editorial chair of the *Coal Age*, has been saying things again about inland water transport in the United States and saying them in a lugubrious, a sort of hopeless, vein. He makes out a bad case for all American inland water commerce, of course excepting that on the Great Lakes, and there is a great deal of negative truth in what he says. Early in the summer he analyzed the findings of Mr. CHARLES WHITING BAKER, contained in a series of articles Mr. BAKER prepared for the *Engineering News-Record*, adding his own views and commendations.

Both of these writers have attacked the subject of waterways from a negative angle, and their adverse criticisms are destructive, rather than constructive, though the latter sort of engineering criticism seems to be what is called for in the premises. Mr. PARSONS calls attention to what we presume is a fact, that the United States Government and the State Governments have spent approximately three quarters of a billion dollars on our inland waterways, "and yet our rivers and canals have never amounted to much as carriers of freight."

Whether in the sum of three quarters of a billion mentioned by Mr. PARSONS is contained the cost of Great Lakes channels such as those at the Sault Ste. Marie Canal, St. Mary's River, the St. Clair River, St. Clair Flats, Lake St. Clair and Detroit River, the Chicago River, and the many harbor improvements about the Great Lakes is not touched upon, but these costly and practical and necessary water facilities must have constituted a respectable percentage of the total. The money is not begrudged that has been spent about the Great Lakes, both Mr. PARSONS and Mr BAKER will doubtless admit, and many millions more should be spent around the Lakes, especially on the St. Lawrence Tidewater project to open up the Lakes to the sea, which may cost a quarter of a billion in itself, and eventually be worth to the United States many times that sum.

But it seems to us that if any considerable part of three quarters of a billion invested in inland waterways in America is unproductive of the kind of results the expenditures were intended to insure, that instead of taking one's typewriter in hand to damn waterways indiscriminately (always excepting the Great Lakes) it would be the proper role of the engineering editor to essay some helpful suggestions as to how the public as a whole can get some benefit from these waterways that have cost so much.

If canals and waterways are not being used, after being built, why not institute an intelligent, constructive campaign, under competent engineering authority and expert traffic authority, to get the most that is possible out of these waterways. This would be preferable to folding one's hands resignedly and in effect saying: "Let freight take the costly rail routes, which are already so regularly congested from car shortage that the companies cannot handle the shipments offered to them."

The railroads need no defenders, for they built America, industrially and socially. The nation wants them made efficient, wants them to be equipped properly, wants them to make money, wants their employees to be contented, somewhere within bounds, and desires also that they shall continue to play their enormous part in our economic structure. On the other hand it is highly probable that the great bulk of our population wishes at the same time that some degree of attention be paid to the correlated waterways.

Americans are rather too prone to boast that we lead the world in engineering initiative; certainly we are not lagging in it. Why not apply some of it to the waterways problem, always under the guidance of that faithful and watchful and far-seeing body of men, the engineers of the United States Army. If sentiment, publicly expressed, were directed toward actual utilization of existing waterways in America, now somewhat neglected, we believe that men like General BLACK, who probably knows more about America's internal marine problems than any other living man, could evolve a practical, comprehensive plan for internal waterway traffic that would produce results.

Our friend, Mr. PARSONS, seems unduly pessimistic. Speaking of the $150,000,000-canal system of New York State as the greatest single inland waterway investment ever made in the world, designed for the free use of any one who desires to operate boats upon it, he declares that "measured solely in the light of a business venture the New York Barge Canal is an out-and-out-failure!"

Well! What shall the Empire State do? The State Government has not even finished paying all the bills for that canal system yet. Shall the whole project be shelved and forgotten, or shall ways and means and ideas be provided for getting the most possible out of this magnificent modern system of inland water transport? Which is the better thing to do, admitting that the engineers of fifteen or twenty years ago made some erroneous calculations in the part the barge canal system should play (and they undoubtedly did make some miscalculations): shall everybody merely denounce the New York waterways, or shall something be done to cause their full utilization up to the limit of capacity?

There must be possibilities in that barge canal system. Not so long ago announcement was made that in the first four weeks of navigation this season, the canals had handled 94 per cent. more traffic than in the corresponding period last year. This highly interesting statement has caused widespread comment. It by no means indicates that the case is hopeless. The *Evening Sun* (N. Y.) thinks this "is an unmistakable indication that the period of decay for inland waterways in this country is at an end, and that henceforth the canals will be utilized to carry an ever-increasing percentage of freight."

The truth of the whole matter is that in the last 50 years the growing power and the expansion of the railways has brought stagnation to much of our canal and river facilities. In 1880, for instance, the New York canals (Erie system) carried 4,067,402 tons of freight, but in 1917 only 312,313 tons. The same thing has been true in other parts of America. Locks have fallen into a sad case of disrepair, port facilities have been inadequate, with proper freight handling machinery missing. A few more years and canals would have been matters of memory only.

Conditions brought about by the war have wrought changes, however. There are signs of awakening life in our inland waterways. The railroads have been hampered by restric-

tions and by necessary war time governmental control, and have been unable to expand to meet the great demands upon them, so traffic has been seeking out the water channels again. As far as the inland waterways of New York State are concerned, all that is required is the completion of the canal improvements, the construction of concrete docks, the building of proper warehouses and terminals, laying of connecting rail sidings and the installation of freight derricks or hoists.

Even inland water commerce has risen in cost, of course, but most experts agree that transportation by water is still twenty per cent cheaper than it is by rail. Even if it were not cheaper at all, water traffic would help to relieve the transport congestion. If it isn't cheaper than transit by rail, why the zealous alarm of the all-rail advocates? If a rail haul is the cheaper, alongside a parallel waterway that is available, the shipper will be sure to use the railroad. The most ardent advocate of the use of our waterways could expect nothing else.

Our own thought is that there is every reason to believe that the American nation may well look forward to a period of increasing usefulness and expansion for its internal freight-carrying water courses, and we can see no reason why they should be cried down. Advocating anything but usefulness for every possible means of transportation in America today would appear to be nothing short of a lack of both discernment and patriotism.

CENSUS SHOWS INDUSTRIAL EFFECTS ON POPULATION

THE EFFECTS of growing industries upon the populations of American cities is graphically illustrated by the results thus far announced of the fourteenth decennial census taken by the United States Government. The statistics gathered by the enumerators and tabulated at Washington have shown some astonishing changes in the relative sizes of cities. The figures are regarded as conservative, many municipalities complaining indeed, as is usually the case, that their actual populations are not indicated wholly by the returns announced.

Detroit has attained the distinction of becoming the fourth most populous city in the United States, displacing St. Louis by reaching 993,739 in population, a gain of 113.4 per cent., and outranking Boston, Cleveland, Baltimore and Pittsburgh, all of which cities were larger than Detroit a decade ago. The automobile, motor parts and allied accessory industries are credited, of course, with having caused Detroit to grow from a city of 475,766 to one 527,973 souls larger. It is the only American city of 100,000 or more that has more than doubled its population in the period.

In the April issue of this magazine there was printed in light vein a pure speculation that Detroit would be shown to have reached fourth place with an estimated population of 1,052,987, and that Cleveland would achieve fifth place with 150,000 less. As guesses, these figures were not far off, the Census Bureau's final figures giving Cleveland 796,836, or 42.1 per cent more population than in 1910. Cleveland, like Detroit, has benefited tremendously from its industries.

Another city to astonish the eastern part of America is Los Angeles, which by virtue of its moving picture industry now has the honor of being the largest city of the country west of St. Louis. The California metropolis jumped from seventeenth rank to tenth, displacing so large a city as Buffalo, which dropped from tenth to twelfth place. The eighteen largest cities of America are now the following:

1, New York; 2, Chicago; 3, Philadelphia; 4, Detroit; 5, Cleveland; 6, St. Louis; 7, Boston; 8, Baltimore; 9, Pittsburgh; 10, Los Angeles; 11, San Francisco; 12, Buffalo; 13, Milwaukee; 14, Washington; 15, Newark; 16, Cincinnati; 16, New Orleans; 18, Minneapolis.

THE EDITOR ON INDUSTRIAL INQUIRY IN EUROPE

THE INDUSTRIAL situation in the various European countries is the index of the future. The degree of recuperative power of each nation from the ravaging effects of the Great War can be determined best, for practical purposes, by observations on the resumption of actual manufacturing and selling of goods. The business relations between America, the British Isles and continental Europe will be dependent in the next few years in no small degree upon the ability of manufacturers overseas to equip themselves adequately with machinery that will economically augment their diminished man power.

Machinery and raw materials are gradually being acquired as the result of credit arrangements effected in the first half of this year. Exports from Europe to America are increasing, a helpful and significant circumstance, but the story of the industrial renaissance of the stricken countries overseas has thus far been told only in fragmentary fashion in press dispatches. Transitory statistics on the subject do not matter so much as the basic facts respecting conditions in the factories and what their proprietors must overcome to bring their production up to a point where they can satisfy both their workmen and their customers, while still earning a sufficient profit to expand—a difficult problem indeed.

COMPRESSED AIR MAGAZINE, the only journalistic exponent of a power transmission medium that is paramount in many basic industries, is seeking direct and first hand knowledge on the European industrial situation. Its Editor-in-Chief, and General Manager, FRANCIS JUDSON TIETSORT, sailed from New York for England on July 10 to study actual conditions in the United Kingdom and on the continent and he will give the results of his observations to the 16,000 engineers and industrial executives that read these pages from month to month.

Mr. TIETSORT will prepare a series of articles on conditions as he finds them in the British Isles, Belgium, Holland, France, Spain, and Italy, and possibly in Germany and Austria, the publication of which will be begun this Autumn and extend through winter issues of the magazine. He will naturally pay considerable attention to industrial circumstances affecting pneumatic engineering and the installation of compressed air machinery, as being in the special purview and scope of a technical journal specializing on the subject, but his articles will also reflect the broader industrial aspects and thus they undoubtedly will prove of general interest to all classes of readers.

His wide experience in the last 25 years as a traveler, editor, export sales manager and machinery man will make his observations of peculiar value. While abroad he will also add to the correspondence staff of the magazine engineering writers of note whose work will appear regularly hereafter in these columns. *E. P. M.*

WE CAN'T GO VERY FAR DOWN

IN OUR deepest excavations we do little more than scratch the skin of the earth. How we would like to know what we would find if we could penetrate to a depth of one or two one-thousandths of the diameter of our little ball; but probably—or, rather, certainly—we never will. Sir CHARLES PARSONS, lecturing recently at the Royal Institution proposed the sinking of a shaft to a depth of 12 miles. He first suggested this as far back as 1904 and he thought then that the job could be done in 80 years, but now with the improvements in machinery and methods he thinks that 30 years would be time enough.

Some little consideration, but entirely inadequate, seems to have been given to the unusual difficulties to be encountered. First as to the heat. In countries where the atmosphere is dry, we are told, the sides of mine shafts are cooled by sprinkling them with water, the evaporation of which cools the rock. This effect might be augmented by artifically drying and cooling the air before passing it down the mine. With still greater depths of shaft further methods of cooling would probably be necessary. The heat might be carried upward by means of brine circulated in a closed ring of steel pipes with a rising and descending column, or a simpler method—astonishingly simple—would be to arrange for a rain of liquid air down the shaft. This idea is certainly patentable.

Would it not have been better to have formed some preliminary estimate as to the actual temperatures to be encountered? With a temperature of 60 deg. F. at the surface and a rise of 1 deg. for each 70 ft. of descent the temperature at 1 mile would be 135 deg., and at that depth, or somewhat deeper, the above suggestions would not seem so absurd, but at a depth of twelve miles the temperature would be, say, 965 deg. Why, that is far above the melting points of tin and lead and zinc, and things generally would begin to get red hot.

Another thing that seems not to have been mentioned is the pressure of the air. At a depth of only 6 miles this pressure would be as great as that the sand hogs work in, in one hour shifts, when driving subaqueous tunnels or sinking foundation caissons, and at twelve

miles the absolute pressure would be about 150 pounds.

It is further suggested that when sinking the deeper portions of the shaft probably shields would be required to protect the miners from the splintering of the rock, since the intensive compressive stress splits off scales from the surface, sometimes with considerable violence. This danger would increase at an incomputable rate with the increase of depth and suggests the necessity of following the sinking closely with heavy lining.

It is a curious thing, which could not have been predicted a score of years ago, that we can now go from sea level farther upward than downward, but the limits in either direction though not sharply fixed are nevertheless absolutely impassible, and it would be well for us to make ourselves as comfortable and contented as possible in our vertical captivity.

R.

British investigators of oxygen mine rescue apparatus bring out the curious fact that while the extra supply of oxygen will enable the average man to walk faster and with greater comfort than is possible in the open air, those long accustomed to the mine atmosphere do not find the same benefit. It is thought that their lungs have become adapted, through years of hard labor, to make fuller use of the oxygen normally in the atmosphere.

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Book Reviews

HOW TO MAKE AND USE GRAPHIC CHARTS, by ALLAN C. HASKELL, B. S., principal assistant, Construction Service Company, with an introduction by RICHARD T. DANA, consulting engineer. First edition; first impression. Illustrated with charts and diagrams. Price, $6. New York: Codex Book Co.

SINCE 1908 there have been published a half dozen books having to do with the functions performed by graphic charts. Among them may be noted the admirable treatise of Prof. M. d'Ocagne of the *Ecole des Ponts et Chaussees* on the mathematics of charts (1908); *The Construction of Graphical Charts* by Professor Peddle (1910); *Graphical and Mechanical Computation* by Professor Lipka (1918); *Graphic Methods for Presenting Facts* by Brinton (1914). Each of these books has been valuable in considering the general subject, the first three being regarded as indispensable for any one investigating the theory of chart construction, while Mr. Brinton's book is useful as furnishing a collection of illustrations pertaining to the use of this method for demonstration purposes.

In connection with Mr. Haskell's new book it should at once be noted that there are, however, at least seven distinct and most important functions that may be performed by graphic charts, several of them simultaneously and each of them is susceptible of being accomplished by this method, always as well as, and generally more perfectly than, in any other way. It is for the purpose of showing this peculiar adaptability to all these functions, Mr. Dana points out in his introduction to the volume, that Mr. Haskell has written the present book, and also to show, with the minimum of mathematical elaboration, how best and most effectively to make use of the method for the current engineering problems of today.

The writer is frank to confess that, while he pretends to be not entirely innocent of aptitude with figures, he has found irresistible the temptation to make his computations by the simple drawing of straight lines on variously ruled paper, rather than developing his weary mind through the exercise of algebra, and mayhap the calculus, in twice the time. It may be an admission of mental indolence, or worse, but he has always preferred the simple and easy methods, especially where mental effort was involved. He has been unable to appreciate the attitude of a very dear friend of his who declined to use a slide rule for the reason that "it might spoil his arithmetic."

The uses of the new logarithmic paper are described in Mr. Haskell's excellent book, as well as the principal functions of charts. So much is contained in this invaluable treatise that it would be an unavailing job to attempt to narrate its contents, which will be absorbed with avidity by engineers who desire to procure new ideas for the uses of the various rulings and by novices who may wish to learn as simply as possible the many advantages to be derived by becoming familiar with this method of presenting facts. For these admirable purposes the book is heartily to be commended.

MODERN METHODS IN THE OFFICE, by H. J. BARRETT. How to Cut Corners and Save Money. Price, $2 net. New York and London: Messrs. Harper & Brothers.

THE AUTHOR of *Dollars and Sense* and of *Salesmanship* produced in this book on economical, but still efficient, office practice a treatise that is chock full of practical pointers gained from every-day experience. It is really invaluable for everybody in the office, from office boy and stenographer down to manager, and will help to teach the boy how to become boss in time. If the reader gains only one sound point that is new to him, he should be fully repaid. The writer has tried to touch upon the work of all hands in the office, whether that office be a little one-room establishment, or the extensive headquarters of a large corporation.

SHOP MANAGEMENT, by FREDERICK WINSLOW TAYLOR, M. E., Sc. D., Past President of the American Society of Mechanical Engineers, and author of The Principles of Scientific Management, with an introduction by HENRY R. TOWNE, President of the Yale & Towne Mfg. Co. Price, $2 net. New York and London: Messrs. Harper & Brothers.

THIS BOOK is a practical exposition of the theories given to the world in *The Principles of Scientific Management*. Here Doctor Taylor shows how they have actually accomplished the seeemingly impossible—higher wages and increased dividends with the same products at the same prices—in the shops, yards, and factories of different industries. This is intended as a practical book, and is somewhat more technical in character than its predecessor, which achieved celebrity when Louis D. Brandeis declared that by its adoption the railroads of the country could save a million dollars a day that is now wasted.

The author is one of the distinguished engineers of America and for nearly thirty years has been at work on the principles enunciated in his books. Doctor Taylor believes that the *man* is the main thing in industry.

In his Foreword, Mr. Towne writes admiringly of the achievements of Doctor Taylor in his peculiar field of investigation, and he emphasizes the fact that industrial engineering, of which shop management is an integral and vital part, implies not merely the making of a given product, but the making of that product at the lowest cost consistent with the maintenance of the intended standard of quality. The attainment of this result is the object which Doctor Taylor has had in view during the many years through which he has pursued his studies and investigations. The methods explained and the rules laid down in this monograph by him—probably the most valuable contribution yet made to the literature of industrial engineering—are intended to enable and assist others engaged in this field of work to utilize and apply his methods to their several individual problems.

The Chicago Pneumatic Tool Co., 538 South Dearborn Street, Chicago, announces the appointment of L. T. Pockman as district manager of its Los Angeles territory. Mr. Pockman's office will be at 307 East Third Street, Los Angeles.

Notes of Industry

The report on exports of dyes and dyestuffs by the Statistical Division, Bureau of Foreign and Domestic Commerce, states that the total amount exported from the United States during the year 1919 was $17,084,435. Japan was the largest importer with $3,196,550, and Canada second, with $2,143,097.

A conservative estimate of the amount of steel supplied during the war to combined armies and navies of the Allies by steel industries of America has been placed at not less than 100,000,000 tons.

Duluth ore shipments for May, 1920, from the Lakes and Ashland docks were only 75,200 tons behind last year, considering restrictions in operations due to shortage of coal. The amount was 5,805,375 tons against 5,880,595 tons.

Owing to close union with the government in relation to war work, very little information has been divulged concerning operations of the Submarine Signal Co., but from now on the knowledge acquired will be extended to the commercial field.

According to announcement from Charleston, W. Va., activities in the southern coal fields have added 27 operations in the last ten days to those previously existing.

Experiments are being conducted at the Textile Institute, Leeds, England, for the manufacturing by chemical process of artificial wool and cellulose derived from cotton waste.

The Ford Motor Co. has plans under way for a production of 4,000 cars per day. This program would not indicate that the elmination of low priced cars is nearer at hand than at any other time in recent years.

From the large number of options for rentals and acquired oil rights the indications are that Tampico oil field in Mexico will become a scene of much activity, as the oil can be extracted profitably and in commercial quantities.

Gen. Alvarado, secretary of finance of Mexico, denies that American interests have financed the recent revolution, but states that the sugar interests of Sinaloa advanced $100,000 as payment on taxes when the movement started. This has been repaid by rebating on sugar shipments. The Mexican department of finance has also decided to pay all proved claims of damages suffered by Americans during revolutions since the revolt in 1910.

Recent tests to determine the proper amount of air required for special thermit welding gasoline and compressed air preheaters showed that 25 pounds per square inch seems to be a practical minimum. At this pressure, a single burner preheater will require approximately 25 cubic feet of free air per minute and a double burner preheater approximately 50 cubic feet. For very large welds, where the walls of the molds are thick and the preheater gates longer than usual, a pressure of 40 pounds per square inch would be advisable. This would require approximately 35 cubic feet of free air per minute for a single burner and 70 cubic feet of free air per minute for a double burner.

LABOR IS GROUND DOWN TO THE LAST LIMIT, HIS NOSE TO THE GRINDSTONE A SLAVE OWNED BY HIS MASTER A MERE SERF!
BOLSHEVIST
YOU'RE A LIAR
LABOR
U.S.
AIR TOOLS
BOLSHEVIST
GUIDO JANES

COMPRESSED AIR MACHINERY VS. THE LABOR RADICAL

The Mexican oil shipments for May totaled 11,200,124 barrels, according to the *Wall Street Journal,* and in consequence of the increased assurance with which operators are proceeding, interesting results are being obtained.

The great irrigation pump installed in the Glenn-Colusa Irrigation District is believed to be among the largest in the Western states. The discharge pipe of the pump is ten feet in diameter and throws 375 cubic feet per second. The pump is the seventh, and largest, to be installed at the head of the system to take water from the Sacramento river.

A machine rated to pierce a hole 4 in. in diameter and 150 ft. long, horizontally, in heavy clay in half an hour was described in detail in the *Engineer,* England, issue April 9. The machine is intended for cable laying, pipe laying, draining and similar work. It operates on the principle of thrusting a stick into clay, and there is therefore no spoil.

Five hundred exposures per second is the record in film photography made by two French scientists. They used electric sparks emitted by a special apparatus, and were able to take a detailed and accurate kinematograph record of the track of a revolver bullet. The cone of gas leaving the barrel before the bullet itself was clearly visible and the track of the bullet was clearly followed. Scientists forecast that this invention will enable accurate photographs to be taken of every form of movement in the human organism.

The average passenger car consumption per year is 300 gallons, and the average motor truck consumption 1,500 gallons, according to the National Automobile Chamber of Commerce.

A Japanese commission is being formed to make a study of American and European tunnel construction practice with a view to throwing light on the cost and main construction problems in the proposed 10-mile tunnel under Shimonoseki Strait. This tunnel would connect the main island of the Japanese group with the island to the south on which the city of Nagasaki is situated and where large industrial development has taken place.

An automatic wireless call device was recently described by Major Basil Binyon before the Wireless Society of London. By means of an aerial which had been erected, Major Binyon was able to give a practical working demonstration of this novel piece of mechanism. Pre-arranged messages were received from the wireless station at Slough, and the selector mechanism proved beyond doubt that it would respond only to signals for which it was set to receive. By the use of this apparatus it is only necessary to employ one operator on board ship, since during the less busy hours of the day the automatic call device may be left to take incoming signals. On the receipt of a message giving the call signal of the ship in which it is installed, or the distress signal S. O. S., a relay is put in action, a bell rung, and the operator called to his instruments.

Latest U. S. Patents

JUNE 1

1,341,752. LIFE-SAVING DEVICE. Feodosy Lavryk, Chicago, Ill.
1,341,872. DRAFT-REGULATOR. James O. Anderson, Eugene, Ore.
1,341,915. COMBINED WATER AND AIR PUMP FOR AUTOMOBILES. John W. B. Ladd and Ralph E. Rich, Chicago, Ill.
1,342,135. PULVERIZED-FUEL FEEDER. Lawrence S. Schmidt, Pittsburgh, Pa.
1,342,152. AIR-CLEANING VENTILATOR. Ashley C. Bennett, Minneapolis, Minn.
1,342,180. PNEUMATIC MECHANISM. James O'Connor, New York, N. Y.
1,342,184. PROCESS OF PRODUCING MOLDED OBJECTS AND APPARATUS FOR USE IN CONNECTION THEREWITH. Philip Rauer, New York, N. Y.
1,342,193. AIR-INLET DEVICE. Victor H. Van Sant, Newark, N. J.
1,342,206. WINDMILL. Jacob Christian Hansen-Ellehammer, Copenhagen, Denmark.
1,342,214. AIR MOISTENING AND HEATING SYSTEM. Robert W. Hardie, White Plains, N. Y.
1,342,291. PROTECTED PNEUMATIC HEEL. William Edward Kay, Elyria, Ohio.
1,342,345. PORTABLE SUCTION CLEANING-MACHINE. David P. Moore and Samuel B. Pack, Washington, D. C.

JUNE 8

1,342,487. AIR COMPRESSOR AND REGULATOR. Guy F. Wolfe, Frederick, Md.
1,342,491. WATER-SUBMERGED AIR CHAMBER FOR WATERPIPES. Howard H. York, Logansport, Ind.
1,342,501. HOT-AIR MOTOR. Lloyd D. Freeland, Halbrite, Saskatchewan, Canada.
1,342,540. FLUID-OPERATED TOOL. Charles A. Hultquist, Los Angeles, Calif.
1,342,593. VACUUM CLEANING MACHINE. William V. Orr, Cleveland, Ohio.
1,342,682. HYDRAULIC AIR-MOTOR. John A. Knowlton, Dorchester, Mass.
1,342,709. ORDNANCE RECOIL AND RUN-OUT APPARATUS. Arthur Trevor Dawson and George Thomas Buckham, Westminster, London, England.
1,342,811. AIR-MOTOR. Olaf F. Howe, Missoula, Mont.
1,342,984. VACUUM PNEUMATIC HAMMER. James C. Campbell, New York, N. Y.
1,343,004. PNEUMATIC PUMP. Guy M. Russell, Rochester, N. Y.
1,343,016. CASTING APPARATUS. Francis H. Vallender, Arlington, Mass.

JUNE 15

1,343,190. AUTOMATIC VALVE FOR AIR LIFT PUMPS. Herbert T. Abrams, Orange, N. J.
1,343,270. ENGINE-DRIVEN AIR-COMPRESSOR. Iwan Lychyj, Sault Ste. Marie, Ontario, Canada.
1,343,350. SAND-BLAST TUMBLER. Samuel Coburn, Birmingham, Ala.
1,343,357. PNEUMATIC CUSHION. Anton C. Eggers, Brooklyn, N. Y.
1,343,497. RIFFLED PNEUMATIC CONCENTRATING-TABLE FOR GRAVITATIONAL SEPARATION OF COMMINUTED MATERIAL. Charles W. Eccleston, Los Angeles, Calif.
1,343,510. AIR-LIFT FOOTPIECE. Arthur B. Jennings, New York, N. Y.
1,343,536. COMPRESSOR APPARATUS. Walter S. Weeks, Berkeley, Calif.
1,343,560. AIR-SPRING. Lucien R. Gruss, San Francisco, Calif.
1,343,591. VACUUM-TANK. William Sparks, Jackson, Mich.
1,343,610. FLUID-OPERATED PERCUSSIVE TOOL. Lewis C. Bayles, Easton, Pa.
1,343,649. VALVE FOR PERCUSSIVE TOOLS. William A. Smith, Easton, Pa.
1,343,694. FLUID-PRESSURE BRAKE. Walter V. Turner, Wilkinsburg, Pa.
1,343,701. PNEUMATIC CORE-WIRE PULLER. Burton S. Aikman, Milwaukee, Wis.
1,343,718. AIR-MOISTENER. Robert W. Hardie, White Plains, N. Y.
1,343,797. AERATION OF SEWAGE AND OTHER IMPURE LIQUIDS. Oswald Stott, Birmingham, and Ernest Reginald Jones, Stourbridge, England.
1,343,852. FLUID-PRESSURE COUPLING. Sidney Augustin Rousseau, DeWitt, Ark.

JUNE 22

1,343,894. AIR-CONDITIONING APPARATUS FOR DRYING-KILNS. Hervey N. Andrews and Roy M. Holmes, South Bend, Ind.
1,343,922. AIR-PUMP FOR EVACUATING AIR FROM CONDENSERS, REFRIGERATING PLANTS, AND THE LIKE. Birger Ljungstrom, Stockholm, and Fredrik Ljungstrom, Finspong, Sweden.
1,343,940. MOLDING-MACHINE. John T. Stoney, Cleveland, Ohio.
1,343,951. VALVE FOR PNEUMATIC TOOLS. William Sidney Whyte, Bedford, Ind.
1,343,987. GLASS-PRESSING MACHINE. Frederick W. Stewart, Beaver, Pa.
1,344,057. AIR-CIRCULATING APPARATUS FOR CARS. Charles A. Moore, St. Paul, Minn.
1,344,104. BUBBLE-BLOWER. Claude U. Tyrrell, Chicago, Ill.
1,344,126. MOLDING-MACHINE. Philetus W. Gates, Chicago, Ill.
1,344,170. COMPOUND PNEUMATIC IMPACT-TOOL. William Burlingham, Newport News, Va.
1,344,258. PROCESS FOR MAKING PETROL OR GASOLENE. Charles R. Burke, Tulsa, Okla.

1. The process of making gasolene from heavier hydrocarbon oil which consists in distilling such heavier hydrocarbon oil under pressure, then mixing natural gas with the vapor resulting from said distillation, then passing the combined vapors through a compressor and then condensing the same.

1,344,328. PNEUMATIC CONTROLLER. Stanley Byrne Turner Worden, Syracuse, N. Y.
1,344,509. AIR-COMPRESSOR. William C. Hampton, North Manchester, Ind.

Recent British Patents

Abstracted for COMPRESSED AIR MAGAZINE By Messrs. John E. Raworth & Moss, London

138,032. VALVE GEAR FOR PERCUSSIVE TOOLS. G. H. T. Rayner of Sheffield and P. Rayner of Sheffield.
138,304. PERCUSSIVE ROCK DRILLS. G. H. T. Rayner of Sheffield and P. Rayner of Sheffield.
138,576. VALVE GEAR FOR PERCUSSIVE TOOLS. G. H. T. Rayner of Sheffield, and P. Rayner of Sheffield.
138,577. VALVE GEAR FOR PERCUSSIVE TOOLS. G. H. T. Rayner of Sheffield, and P. Rayner of Sheffield.
139,300. PUMP. G. W. Pearce & Sons Ltd., of Birmingham and A. E. E. Jones of Birmingham.
139,332. TYRE INFLATING PUMP. The Rotax Motor Accessories Co., Ltd., and H. Aron of London.

Personal Intelligence

Mr. Allan E. Goodhue has been elected Vice-President of the Chicago Pneumatic Tool Co. in charge of sales. Mr. Goodhue has been managing director of the company's subsidiary, the Consolidated Pneumatic Tool Co. of London, and returned from Europe in time to permit assuming his new duties early in July.

* * *

R. S. Cooper, vice-president and general sales manager of the Independent Pneumatic Tool Co., of Chicago, will leave shortly for London for the purpose of opening an European office.

* * *

W. G. Grace, chief engineer of the Greater Winnipeg Water District, has resigned to connect with a Manitoba corporation known as the Research & Development Co., Ltd. It is the purpose of this corporation to initiate new industries and enterprises in the commercial interests of Manitoba.

* * *

Mr. A. S. Fuller has returned to Porcupine after spending several months in New York. Mr. Fuller is involved in a large deal comprising fifteen Porcupine gold mine properties.

* * *

Mr. Horace V. Winchell has been retained as chief geologist by the Hecla Mining Co., and has been in Spokane, Wash., recently in connection with the pending litigation between the Hecla and Marsh mines in Coeur d'Alene.

* * *

Mr. Edward P. Merrill has been appointed general manager of the Dominion Iron & Steel Co., and the Dominion Coal Co. of Sidney, N. S. Mr. Merrill has had considerable experience in the operation of coal mines in the United States and spent several years in Mexico in the electrification of mines. H. J. McCann has been appointed assistant general manager to Mr. Merrill.

* * *

Mr. Morris Bien of the U. S. Reclamation Service, has been appointed to the newly created position of assistant director.

* * *

James F. Parks, superintendent of the Plymouth Consolidated Gold Mines of Amador County, Cal., died recently at the hospital in Sacramento following an operation for appendicitus. His father was the late James F. Parks, formerly manager of the Kennedy Mining Co., and like his son, was one of the famous mining men of California. Two sisters, Mrs. Frederick W. Bradley and Mrs. John F. Davis, survive him.

* * *

Capt. J. Roy Pennell, of Columbia, chief engineer of the South Carolina highway department, expects to leave the highway department when the new commission is familiarized with the work. Captain Pennell will open an engineering office in Columbia, S. C.

* * *

At the recent annual meeting of the Engineering Advertisers' Association of Chicago, officers for the ensuing year were elected as follows:

President, A. H. Hopkins, advertising manager, the C. F. Pease Company; Vice-President, J. J. Arnsfield, advertising manager, Fairbanks-Morse Company; Secretary, G. S. Hamilton, advertising manager, American Steam Conveyor Corporation; Treasurer, E. I. Pratt, advertising manager, Kellogg Switchborad & Supply Co.

* * *

G. F. Hess, superintendent of machinery of the Kansas City Southern, has been appointed superintendent of motive power of the Wabash at Decatur, Ill.

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Powell Co., The Wm.	19
Republic Rubber Co.	12
Scaife & Sons Co., Wm. B.	22
Sprague Electric Works	16
Stearns-Roger Mfg. Co.	2
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Announcement of Technical Books

COMPRESSED AIR DATA, by William Lawrence Saunders and Charles Austin Hirschberg.

Price, Domestic, $3.00 Net, Postage Paid.

COMPRESSED AIR PRACTICE, by Frank Richards, Technical Editor of Compressed Air Magazine.

Price, $3.00 Net, Postage Paid

COMPRESSED AIR FOR THE METAL WORKER, by Charles Austin Hirschberg.

Price $3.50 Net, Postage Paid

FLOW AND MEASUREMENT OF AIR AND GASES, by Alec B. Eason, M. A., Associate Member of the British Institute of Electrical Engineers

This book, just issued, is one of the most valuable compressed air technical books issued in years. It is an indispensable engineering work for those delving deeply into the subject, quoting 250 authorities.

252 Pages, with charts and equations. Price $7.50, postage paid.

MECHANICAL ENGINEERS' POCKET BOOK, by William & Robert Kent.

1526 Pages, 4x6¾. Fully illustrated. $6.00 Net.

COMPRESSED AIR PLANTS, by Robert Peele.

A thoroughly practical book with full information gathered from actual work in all lines and formulas, rules and tables for the necessary computation.

518 Pages 6x9, 209 Illustrations. $4.50, Postage Prepaid.

COMPRESSED AIR THEORY AND COMPUTATION, by Prof. Elmo G. Harris.

An authorative work that has been especially useful because of the charts, tables and clear, concise discussion of fundamental theory.

The second edition represents a thorough revision and an enlargement, consisting of a new chapter on "Centrifugal Fans and Turbine Compressors;" also an appendix on the Design of Logarithmic Charts.

192 Pages 6x9, Illustrated, $2.50.

PRACTICAL APPLIED ELECTRICITY, by Prof. Moreton.

Air workers must know much about electricity, and there is no book from which all the essentials can be so readily and so completely obtained as this.

440 Pages 7x4½, 430 Illustrations. $2.00 net, Postage Prepaid.

AIR COMPRESSION AND TRANSMISSION, by H. J. Thoekelson.

Contains clear, simple explanations of the thermodynamic phenomena involved. Of value to Designers, Consulting Engineers, Factory Superintendents and Operating Engineers.

207 Pages 6x9, 143 Illustrations. $2.00 (3-4), Postage Prepaid.

THE SUBWAYS AND TUNNELS OF NEW YORK, by Gilbert-Wightman and Saunders.

It is absolutely true that the cost of these works, built and building, is greater than that of the Panama Canal and this book tells about them.

$5.00 net, Postage prepaid.

AMERICAN CIVIL ENGINEERS' HANDBOOK, by Mansfield Merriman, Editor-in-Chief, and a Staff of Experts.

Fourth Edition, Just Published, 1955 Pages. Price $6.00.

HANDBOOK OF COST DATA, by Halbert P. Gillette.

Gives methods of construction and detailed actual costs of material and labor on all kinds of engineering work.

1900 Pages, numerous Tables and Illustrations, $6.00.

HANDBOOK OF ROCK EXCAVATION, by Halbert P. Gillette.

An eminently practical work covering fully and completely the drilling, excavating, quarrying and handling of rock.

840 Pages, 184 Illustrations, 87 Tables, $5.00.

CONCRETE CONSTRUCTION METHODS AND COSTS, by Halbert P. Gillette and Chas. S. Hill.

Treats of concrete and reinforced concrete structures of all kinds, giving working details and full data of costs.

700 Pages, 300 Illustrations, $5.00.

CIVIL ENGINEERS' POCKET BOOK, by Albert L. Frye.

An encyclopedia of engineering and necessary labor saver in all planning and estimating.

1600 Pages, numerous Illustrations and innumerable Tables, $5.00.

MECHANICAL AND ELECTRICAL COST DATA, by Gillette and Dana.

This is the only handbook devoted exclusively to the costs and economic data of mechanical and electrical engineering.

1734 Pages, 4½x7, Flexible, Illustrated, $6.00.

GAS, GASOLINE AND OIL ENGINES, by Gardner D. Hiscox.

The only complete work on the subject. Tells all about the running and management of gas, gasoline and oil engines, as designed and manufactured in the United States.

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